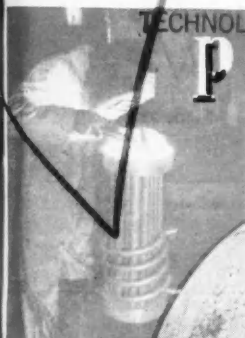


The Chemical Age

VOL LXV

27 OCTOBER 1951

No 1685



TECHNOLOGY DEPT.



Pioneers in the welded

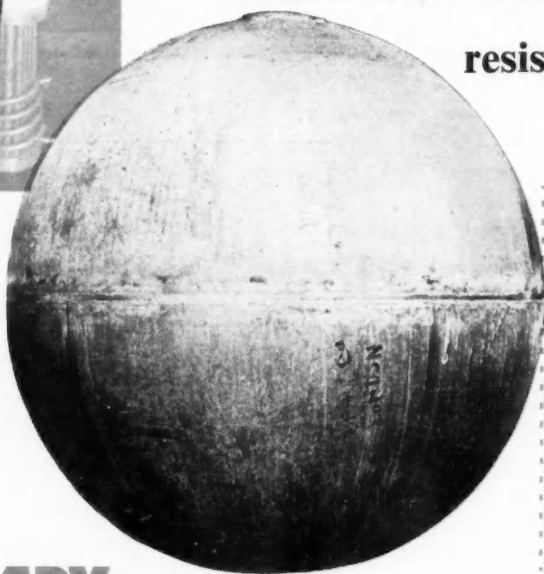
fabrication of corrosion-

resisting metals

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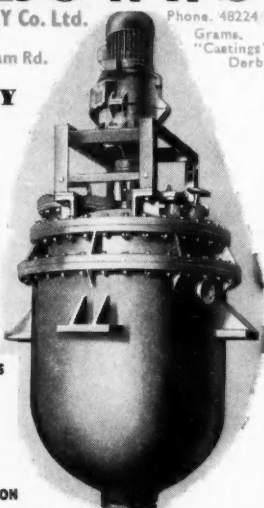
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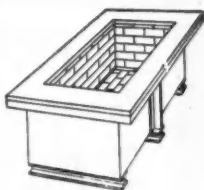
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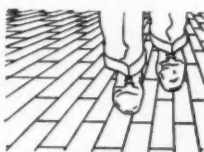
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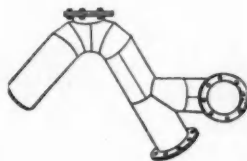
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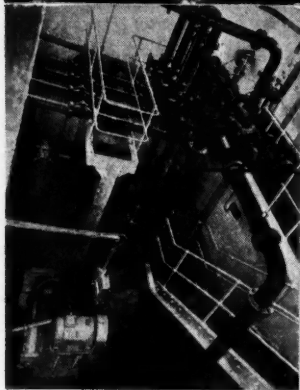
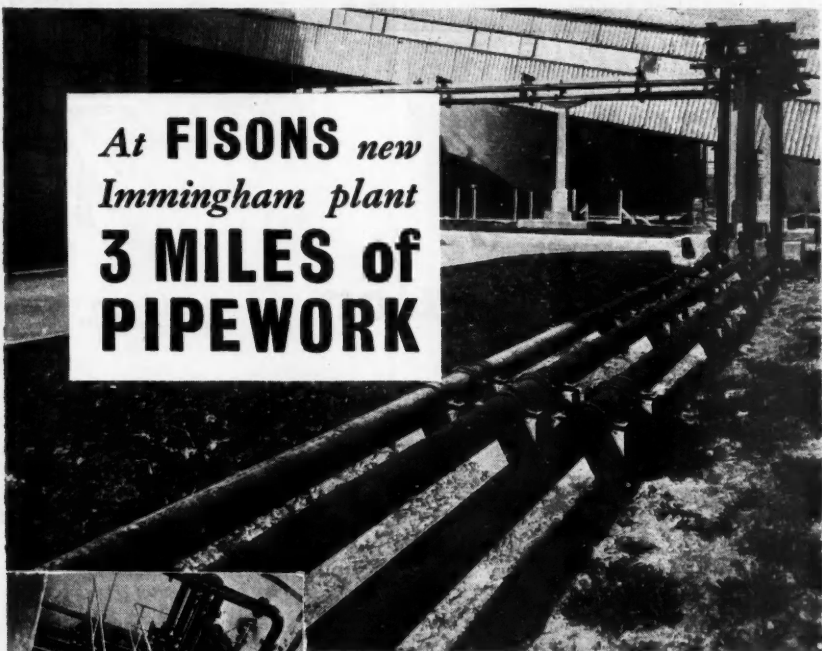
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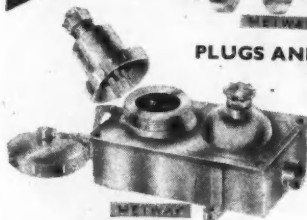
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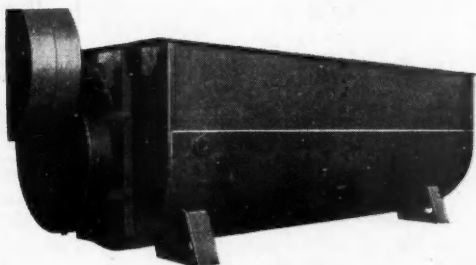
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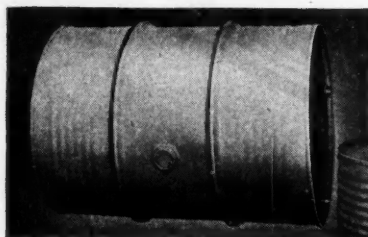


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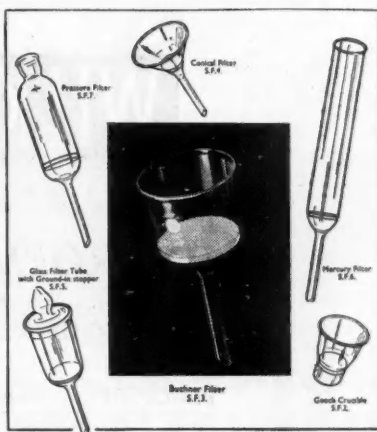
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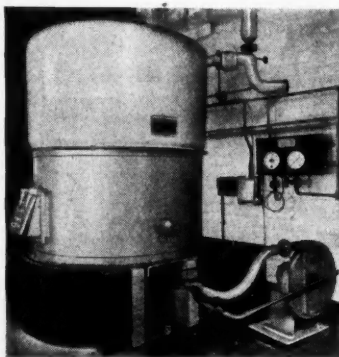
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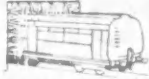
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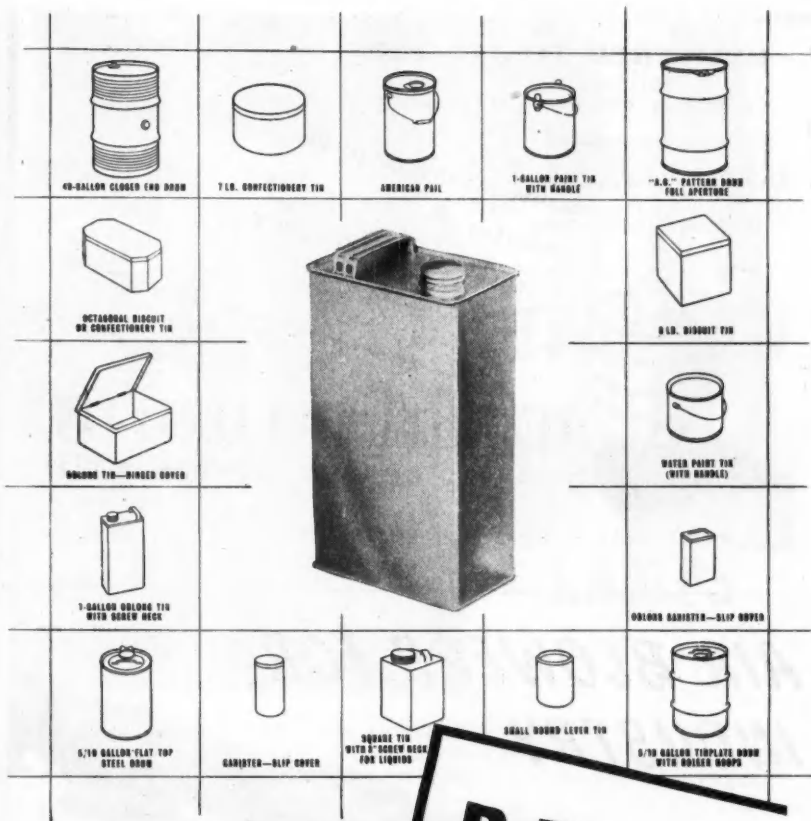
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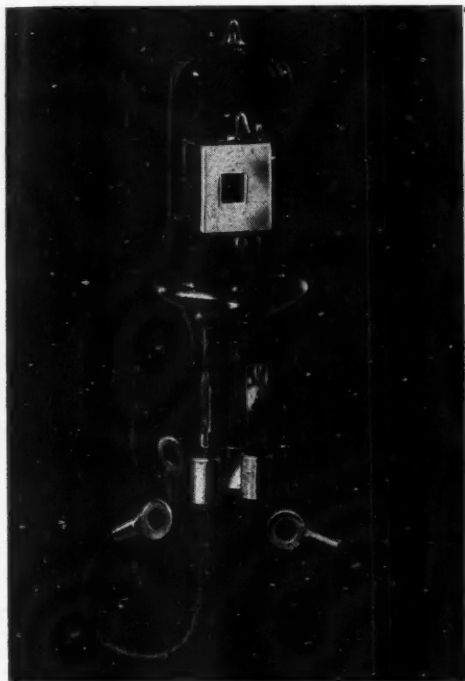
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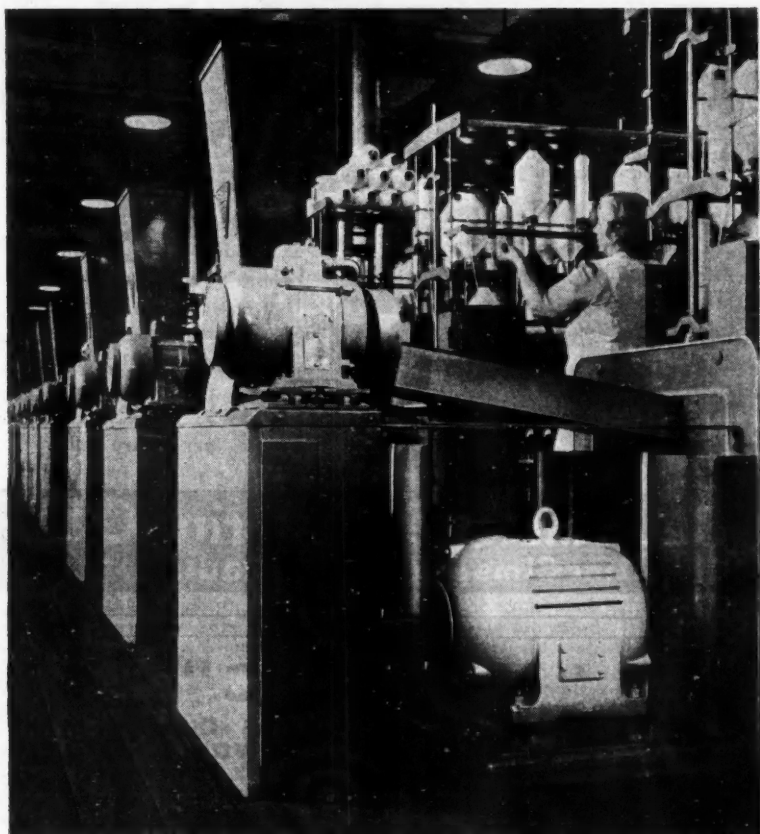
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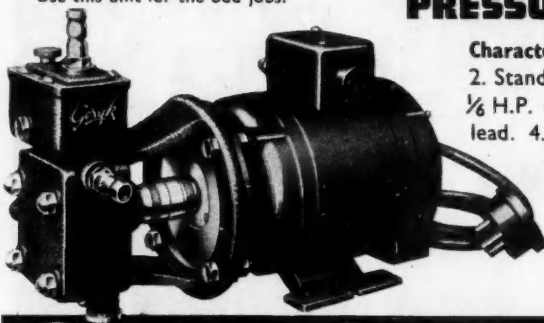
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Volume LXV

27 October 1951

Number 1685

Pure & Impure

IN a recent issue our distinguished contemporary, *Discovery*, expressed concern about the position of pure or fundamental research. The really great advances all spring from discoveries made in pure science. Those initial discoveries may sometimes be no more than chance by-products of an 'academic' investigation, yet they can lead to great new departments of technology and industry. The antibiotics and the growth-regulating substances of agriculture are examples within our own time. Research in applied science is certainly important and most of us realise that it was insufficiently encouraged before the war; but it is a form of long-term matricide for efforts in applied science to expand at the expense of pure science. A balance between the two kinds of efforts must be judiciously maintained.

One of the most dangerous factors operating against pure scientific research today is its high cost. The facilities needed, especially equipment, require more and more money. This is not simply a matter of inflation though rising costs certainly play a significant part. Far more serious is the fact that increasingly complex apparatus is now required to push the front of science further

ahead. Thus, if £500 per annum as a grant secured so much effort ten years ago, the same sum today cannot secure even half the effort. The proportion is more likely to work out at a quarter or less; or, conversely, it requires £2,000 today to support the amount of pure research that £500 would have supported formerly. The scientist with a genuine capacity for research is in a similar situation to the poet or writer of Elizabethan times—he must find a rich patron. That patron must be the State, a university (whose funds in any case mainly derive from the State), or industry in the shape of a large company or an industrial association.

In recent years there has been a praiseworthy expansion in all these pipelines of economic patronage but with greater public investment in research a tendency for greater control of the research worker has not unnaturally arisen. Yet for pure research pure freedom is essential. The exploratory journey cannot be charted and time-tabled in advance. The first-class worker must be free to switch his effort and interest from an initial target to some sudden and unexpected development that seems more important; and he, above all, must be the principal

judge of the wisdom in making such diversions. However much it may be feared that such complete freedom for the individual will lead to wastage, to blind alleys or to the over-lapping of efforts by different workers, the desire of fund-awarding committees to lay down fixed programmes must be suppressed. Their task is to pick the right men to support, to support them adequately, and thereafter to let research follow its own directions. Not every investment in research pays a dividend. Sometimes the dividend is long-deferred. But those dividends that accrue from a few projects are so huge in relation to their capital cost that the 'losses' from the others can be cheerfully written off. There is no executive place for the accountant in research; indeed, if accountancy were fully applied, many a pure research worker of the past should have died a millionaire (at the expense of the public purse) and not a comparatively poor man!

In this country the payment of government grants through the universities is, on the whole, satisfactory. Workers receiving such grants have so far been left with a large measure of freedom. What matters for the future is to ensure that the annual sum paid increases so that at least the present volume of effort can be maintained and that such increases do not bring with them any stronger tendency to impose controls and programmes. The situation is not as satisfactory where research workers are directly employed by the government;

and it will no doubt have been noticed that there have recently been a number of pleas for an increase in the proportion of pure or fundamental research at government research centres. Such centres are well suited for applied research, which can be programmed without much inhibition and sometimes with slight benefit. The pure research worker can play the dual part of university teacher and individual explorer but he can rarely blend his major function with that of being a civil servant.

A few years ago Sir Henry Tizard declared that what we needed was not more research but more application of the research already available. Such is the rate of progress in applied science both in America and Britain, however, that this dictum is no longer quite as sound. Progress is being delayed by gaps in pure science. An increased effort in pure research is needed. That increased effort must not be made by developing pure research in government centres. But it is easier for a government research station or laboratory to get permission and money to increase its buildings. At the same time there are grave indications that grants to universities will be given an annual 'ceiling' equivalent to the sum they now receive. Thus, by an invisible or unstated policy, direct government employment can become the 'patron' of more and more pure research while the universities can maintain less and less. There lies the real danger. And against it scientists themselves must be the watch-dogs.

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Notes & Comments

Authoritative Services

THE increasing interest in and publicity given to chemistry and its impact on everyday life is reflected in the greater attention given to the subject in the popular Press and in talks by the B.B.C. That the public should be kept informed is all to the good, but it is essential that a true picture of the chemical industry and its vital rôle to the prosperity of Britain should be presented. The Association of British Chemical Manufacturers has further developed its proposals for a directory of authoritative sources willing to answer inquiries. The handbook, which it is hoped will be ready for distribution early next year, should help to counter the tendency on the part of some editors and B.B.C. officials to obtain their information on scientific matters from either unreliable or (at best) academic rather than industrial sources.

Chemicals and Poultry Food

IT is now fairly widely known that several antibiotic substances stimulate poultry and cattle growth when added in trace amounts to normal diet. The original discovery arose several years ago as an unexpected consequence of using a waste-product from penicillin manufacture as a feeding-stuff. At the recent World Poultry Congress held in Paris leading research workers from both the United States and Britain emphasised the need for exercising considerable caution in the practical application of this new knowledge. For one thing, it is still not clearly understood why antibiotics have this effect. Withdrawal of the antibiotic from the diet leads to a retardation of growth. The long-term effects are unknown, and there may be factors that influence fertility or production. The influence upon health requires more study. The regular intake of an antibiotic is likely to encourage the development of resistant types of bacteria and this in turn could promote large-scale outbreaks of poultry diseases. It is already known that young chicks are abnormally vulnerable to some diseases when the antibiotic additions to their diet

cease. It is also known that additions of antibiotics to poultry food will not turn poor diets into good ones. The antibiotic seems to enable a good protein-rich diet to give a faster growth-rate; there is little evidence that antibiotics can compensate appreciably for lack of protein in diets. American and British scientists at the Conference said that antibiotic additions should be confined to feeding table birds.

A New Development

A NEW development of somewhat the same kind has been recently announced—again in America (University of Minnesota). An arsenical 3-nitro-4-hydroxyphenylarsonic acid—is also claimed to have growth-stimulating effects. Trace amounts only are involved, roughly 1 lb. of the substance in 8 tons of feed, or 0.00675 per cent. 'With and without' tests have shown that on the same regular diet pigs, chickens, and turkeys make almost 50 per cent greater gains in weight through the addition of this arsenical organic. With the current criticism of 'chemicals in foods' in America, it is difficult to see how a growth-stimulating drug containing arsenic will be popularised. However, the level of arsenic actually in the animal's bodies as a result of this low dosage rate is said to be too small for accurate determination. Nevertheless, arsenic is partly an accumulative poison. It may need a good deal more than laboratory data to convince laymen that the use of arsenic-containing substances to grow fatter birds or pigs is safe. Is there a therapeutic connection between the similar effects of antibiotics and this arsenical drug? One theory for the antibiotic stimulation is that it suppresses growth-retarding bacteria in the digestive tract. Organic compounds of arsenic are also anti-bacterial substances, and the fact that at least one substance of this class can also increase animal growth-rates lends much support to the bactericidal theory. The alternative view, namely, that the antibiotics assist the synthesis of some important trace-nutrient, cannot also explain why an arsenical drug produces similar effects.

German Newsletter

(From Our Own Correspondent)

THE West German chemical industry cannot invest more than Dm. 500,000,000 a year, at the most, in new plant and extensions said W. A. Menne, president of the German Federation of Chemical Industry, in a speech at Hamburg last week; U.S. chemical firms, he added, were investing twenty times this amount in new plant. In the first seven months of this year exports of chemical products from West Germany reached Dm. 1,200,000,000; they thus exceeded the export total of 1950 which in turn had surpassed the 1949 figure threefold.

Three Aids Needed

For a further improvement of the export business, however, he said, official assistance was required; export promotion, improved coal supplies and help in obtaining long-term finance were the three aids which the industry needed. German export trade is likely to benefit from special arrangements made to give raw materials for export goods priority over other manufactures through a Federal Government agency.

Knapsack-Griesheim AG für Stickstoffdünger und Autogentechnik is the name of a new company under U.S. administration set up to take over several former I. G. Farbenindustrie works. The new company which is domiciled at Knapsack near Cologne has emerged from the amalgamation of AG für Stickstoffdünger, with works at Knapsack, Griesheim-Autogen at Frankfurt-Griesheim, Nordwestdeutsche Sauerstoffwerke which owned oxygen plant in eleven towns throughout the British zone. Tegawerk at Kassel-Bettenhausen, and Südwestdeutsche Sauerstoffwerke which operated three works at Stuttgart, Karlsruhe and Heilbronn.

Production Resumed

The works at Knapsack which at the end of the war resembled a field of rubble have been largely rebuilt and early this year were not far from their pre-war production peak. In addition to carbide and cyanamide, the Knapsack works now produce acetylene, acetaldehyde, acetic acid, acetic anhydride and acetone in substantial tonnages, and the production of monochloroacetic acid was

started recently. The new company is the largest producer of acetic acid and related products in Germany and will produce all equipment required for the welding industry, in addition to carbide, oxygen, etc.

The first fundamentally new invention in the field of motor fuel production from coal since 1925 is claimed by Dr. Herbert Koebel, chief chemist of Rheinpreussen Chemische Werke AG, and Dr. Friedrich Engelhardt, one of the company's chemists. Laboratory experiments are reported to have resulted in the development of a new process starting from carbon dioxide and steam which promises to be cheaper than all other synthetic processes. The fuel is said to be suitable for all internal combustion engines and its cost may turn out to be even slightly lower than that of petrol. A small pilot plant is being built to test the process on a semi-commercial scale.

In Soviet-occupied Germany two chemists have been given a National Prize for a process for the production of metallurgical coke from lignite. Eastern Germany is very short of bituminous coal and consequently also of ordinary coke, but possesses large deposits of lignite which are being drawn upon for many purposes for which hard coals would be used in different circumstances. The new process starts from pressed lignite briquettes of high quality. These are carbonised at high temperatures in special apparatus. Present production of metallurgical coke from lignite, however, appears to be small though plans have been drawn up for the erection of a big carbonisation plant in Lower Lusatia where high-quality lignite with a low sulphur content is available. In the meantime lignite coke is produced in small quantities at a converted gas works placed at the disposal of the research team.

Department Moved

The Department of Industrial and Public Relations of Monsanto Chemicals, Ltd., moved on 22 October to Allington House, Allington Street, London, S.W.1. The telephone number is VICTORIA 8131.

BISRA Conference

Spectrographic Analysis Standardisation

SPECTROGRAPHIC analysis of the alloying elements in steel may greatly increase in usefulness as a result of standardisation proposals discussed at a conference organised by the British Iron and Steel Research Association and held on 3 and 4 October at Leamington Spa. Dr. E. Gregory, of Edgar Allen & Co., Ltd., was in the chair.

Although spectrographic analysis may take minutes where older established chemical methods take hours, results obtained in different works often disagree, so that steel suppliers and users have to use time-consuming chemical methods to find a common standard. The problem is being tackled by a BISRA sub-committee (chairman, Mr. S. D. Steele, of Babcock & Wilcox). About 130 delegates from the iron, steel and other interested industries at the fifth annual Chemists' Conference heard Mr. J. H. Oldfield (Bragg Laboratories, Naval Ordnance Inspection Department), describe the work of the sub-committee and outline its proposals for the analysis of low alloy steels.

The proposals included the use of a quartz prism spectrograph; graphite counter-electrodes; an exciter with high voltage and a low capacity condenser with 'uncontrolled' spark; calibration and standardisation of photographic conditions by the use of specified iron spectral lines and line pairs of fixed intensity ratios for evaluation. Reproducibility in these conditions was expressed as a standard deviation percentage of the amount of a given element present in the steel. With 2.08 per cent of nickel present, for example, the standard deviation was 1.5 per cent or an average range from 2.02 per cent to 2.14 per cent of nickel. Generally the standard deviation for commercial low alloy proportions of manganese, nickel, chromium, silicon, molybdenum, vanadium and copper was between 2 per cent and 4 per cent.

Systematic Series

These results are based on a systematic series of spectrographic analyses numbering 54, of which seven were carried out by all 12 members of the sub-committee concerned, and the remainder were each carried out by at least two members. Each member recorded at least 50 spectrograms

on each sample, with not more than five to each plate, the member's assignment being spread over two months. There were thus some 8,900 determinations by the recommended method.

Variety of Papers

Other papers discussed at the conference included:—

'The Determination of Gases in Iron and Steel' by Mr. G. E. Speight (United Steel Companies, Ltd.).

'The Determination of Molybdenum in Low Alloy Steels' by Mr. S. W. Craven (I.C.I., Ltd., Alkali Division).

'The Conflicting Behaviour of Molybdenum, Tungsten and Vanadium in Absorptiometric Analysis' by Mr. C. H. R. Gentry (Philips Electrical, Ltd.).

'The Determination of Vanadium in Ferro-Vanadium' by Mr. B. Bagshawe (Brown-Firth Research Laboratories), and:

'The Determination of Nickel in Highly Alloyed Steels' by Mr. S. Harrison (Kayser, Ellison & Co., Ltd.).

Finally, Mr. W. Bullough (British Iron and Steel Research Association) gave a paper on 'The Disposal of Pickle Liquor with particular reference to Conservation of Sulphuric Acid', in which he discussed batch pickling and continuous pickling of steel sheet. In batch pickling an average of 5.17 lb. of B.O.V. (78 per cent sulphuric acid) was used per basis box of black plate. This could be reduced by adequate inhibition of acid attack on base metal; by working down pickle liquor to give waste liquor low in acid and high in iron content (though the iron content of the second pickling tank should be kept low enough to avoid hydrolysis of the ferrous sulphate and subsequent staining of the plates); and by increasing the time the plates were allowed to drain over the tanks, and even by lightly spraying them to drain again. To reduce drag-out still further the rinse water could be used to spray the plates when taken out of the rinse tank. Mr. Bullough quoted a case where observance of these precautions had reduced acid consumption from 5.17 lb. to 4.7 lb. B.O.V. per basis box, a saving of 11 per cent.

He discussed the various methods of

manufacturing sulphuric acid from the ferrous sulphate crystals remaining after free acid had been recovered from waste pickle liquor. This could be done in pyrites-burning acid plants, or in chamber or contact acid plants, though both these methods had to be worked on a large scale to be economic.

BISRA, however, had developed an auto-oxidation method of producing dilute acid (possibly up to 40 per cent). In this process ferrous sulphate was roasted with coke to give iron oxide and sulphur dioxide, which was absorbed in water and catalytically oxidised to sulphuric acid. Mr. Bul-lough gave a description of a pilot plant to test this process in a works in South Wales, at the rate of 1 ton of dilute acid per day. If the process was a success, full scale plants would probably operate at ten or twenty times that rate.

International Changes

Swiss Speaker's Comments

A NUMBER of interesting and provocative observations on recent changes in the structure of the international chemical industry and on the present situation of the important Swiss chemical industry was made recently at the annual general meeting of the Swiss Society of Chemical Industry held in Montreux, by the Society's president, Dr. A. Wilhelm.

Delivering his presidential address, Dr. Wilhelm saw a dangerous influence at work, as far as the Swiss chemical industry was concerned, in the marked development of chemical industries based on the utilisation of oil and natural gases, both of which formed to an increasingly large extent the basic materials for the manufacture of important chemicals. He emphasised that Switzerland had to be aware of the fact that, as in the case of iron-ore, coal and cokery gases, her situation was remote from petroleum and natural gases, and that this fact would in future become of great disadvantage.

Turning to the expansion of United States chemical influence abroad, the president said that this development was being further accelerated by the Marshall Plan, the OEEC and NATO. 'Not merely single processes are being licensed, whole manufacturing units, including the know-how of erection and installation, arise in non-American industrial

regions' and the speaker left his listeners in no doubt that they would further accentuate Switzerland's disadvantage, as regards location, in several new industries.

After having maintained that the recovery of the German chemical industry would adversely affect Swiss chemistry, Dr. Wilhelm said that the lifting of the prohibition on the manufacture of nitrogen, chloride and aluminium, the freeing of the production of synthetic rubber and of the Fischer-Tropsch synthesis would form a 'mighty impetus' for the German chemical industry. 'As a result of Germany's having become a member of the European Payments Union—the refined inner mechanism of which has, in particularly great measure been of advantage to Germany—her capacity to export to European countries increases', he said. The reconstruction of Germany's trade with overseas was taking place with great vitality and the present boom made it possible to absorb the German delivery volumina without disturbance. In a downgrade economic trend, Germany's exporting power would become more pronounced so that in important markets severe competition between the leading supplying countries would have to be kept in view. It was symptomatic that Japan had also again re-appeared as a supplier of chemical products, namely of dyestuffs, in certain European countries. The political independence just won by this country was being followed by its economic independence whereby competition in the Near East and in the Far East would soon become considerably more severe.

As a result of the fact that large chemical works in Eastern Germany remained intact, an exchange of experience was taking place under Russian guidance, which also benefited Poland and Czechoslovakia. This resulted in a considerable strengthening of the chemical industry in that part of Europe, and in Asia. Assuming a peaceful development during the next few years, the Eastern chemical industry would appear in the export market as an import competitor.

New Factory's Progress

Steelwork of the new factory of the A.P.V. Co., Ltd., at Crawley New Town, is now nearing completion. Some 600 of the company's employees and their wives will visit the site on Saturday next (3 November) when the foundation stone will be laid by the chairman, Dr. Seligman.

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Determination of Organic Halogen

A Survey of Methods Available

NUMEROUS methods are available for the determination of organic halogen.* Many are of long standing and are extensively used in many industrial laboratories. The purpose of this review is to survey the range of methods available and, in particular, to bring to notice some of the procedures developed during the last decade or so. Recent improvements to several of the well-known classical procedures will also be discussed. Methods described are micro or semimicro, unless otherwise mentioned.

The methods of analysis of halogen-containing organic compounds may be classified as follows:—(1) Carius; (2) combustion; (3) bomb; (4) Stepanow; (5) sulphuric acid decomposition; (6) miscellaneous.

In all these methods the organic halogen compound is broken up with the formation of the corresponding halide ion, which is subsequently determined.

Carius Methods: The classical Carius procedure for halogen determination was advanced for macro scale analysis, but in 1910 Pregl developed a workable and satisfactory method based on the original. The organic compound is decomposed by heating in a sealed glass pressure tube with nitric acid in the presence of silver nitrate. The silver halide formed is washed from the tube, filtered and weighed in the usual manner. Despite its simplicity, the method is most reliable and can be applied to liquids and volatile substances as well as to solids. Furthermore, it offers a high degree of precision, because there is no blank incurred during the determination, and because only simple stoichiometric reactions are involved. The method, however, is now obsolescent, mainly due to several prevailing objections. For example, the danger of explosions, the time-consuming heating period, and the possibility of contaminating the silver halide formed with glass splinters cannot entirely be overlooked in view of the fact that several more convenient methods are available.

Difficulties Lessened

The work of Niederl, Baum, McCoy and Kuck¹ is of interest in that it partially minimises some of the difficulties inherent in the

micro Carius procedure. Thus, a differential weighing method has been applied to the determination, obviating interferences from glass splinters; and danger of explosion has been almost completely eliminated by reducing the amount of concentrated nitric acid used by one-third, and by shortening the period of digestion by one-tenth.

Combustion Methods: The organic halogen compound is here decomposed to ionic halogen by combustion in a stream of oxygen and subsequent absorption of the combustion products. The halide is then determined by one of many possible procedures, preferably titrimetric. The original micro method is due to Pregl², who employed a gravimetric method to determine the ionic halogen formed. The advantages of the combustion method over the Carius procedure are its rapidity and its applicability to all types of organic compound.

Pregl's Method

Pregl combusted the sample in a hard glass tube and passed the decomposition products over heated platinum catalysts as in the classical macro procedure of Dennstedt. The halogenated products (HCl , HBr + Br_2 , I_2) were absorbed in a solution of sodium bicarbonate and sodium bisulphite and the halide formed was determined gravimetrically as the silver halide. The iodine procedure was not entirely satisfactory and a new finish was devised by Leipert³. After combustion as before, the iodine is absorbed in caustic soda solution and the resultant iodide ion oxidised with bromine to iodate. After destruction of the excess bromine with formic acid, excess of potassium iodide is added and the liberated iodine titrated with standard sodium thiosulphate solution. In this way, six times the amount of iodine originally present in the sample is liberated, giving a very favourable amplified conversion factor. It is possible to carry out a similar conversion with bromine using a modified procedure, but chlorine does not react in this way.

Hölscher⁴ used the conventional combustion procedure, but absorbed the products in 5 per cent hydrogen peroxide contained in a bubble tube, and titrated the halide formed argentometrically using adsorption indicators to detect the end-point.

* Fluorine was discussed in a separate article (see *CHEMICAL AGE*, 14 July, 1951, p. 47).

Bobranski⁸, working on the semi-micro scale, used barium carbonate to absorb the products from chloro and bromo compounds, and a 40 per cent solution of sodium sulphite for the absorption of iodine. In this way, ionic halogen is produced, which is finally titrated with 0.05N silver nitrate from a weight burette using fluorescein (now, preferably dichlorofluorescein) as indicator for chloride, and eosin, together with starch, as indicator for bromide and iodide.

Lacourt and Chang⁹ absorbed the halogenated products on a 6-7 cm. heated metallic silver gauze placed in the combustion tube immediately after the platinum catalyst. The increase in weight of the silver may be determined, or the silver halide may be extracted and estimated by one of several titrimetric procedures.

Procedure Modified

Schoberl⁷ has modified the combustion procedure by using as catalyst a fritted silica disc contained in the tube. The method is more rapid than the conventional procedure and good results were obtained on all compounds examined.

Perhaps the most striking advance in combustion procedure in recent years is due to Belcher and Spooner⁴, who use an empty combustion tube and a rapid (50 ml./min.) flow of oxygen. Chlorine and bromine are absorbed in alkaline 6 per cent hydrogen peroxide and determined acidimetrically. When sulphur is also present in the sample, the sulphur and halogen combustion products are absorbed in the alkaline peroxide and the total acidity is determined. The halogen is estimated simultaneously by the procedure of Gibson and Caulfield⁵. This rapid combustion technique can be applied to the Leipter method³ for iodine without further modification. The oxygen flow is maintained at 50 ml. per minute, and the free iodine formed is absorbed on a spiral wetted with sodium hydroxide. Combustion is complete in about 5 minutes, and the accuracy obtained is as good as that given by the general standard methods of analysis.

A combustion apparatus, developed by the Shell Development Company of America and manufactured by the Braun Corporation incorporates several new features. As described in their Technical Bulletin, the new apparatus is a compact unitised entrainment designed for rapid, accurate quantitative determination of chlorine, bromine and

iodine (and sulphur) in widely different types of organic substances by procedures which are preferable and superior to other widely used methods. Chlorine, bromine, and iodine are determined individually or simultaneously, by titrimetric procedures. The sample, in a transparent quartz tube, is vaporised and burned in a stream of air passing over quartz rods electrically heated to about 950°C. The acidic combustion products are absorbed in a suitable absorbent and determined electrometrically or polarimetrically. A determination is completed in about 30 minutes. At the present time, the method has only been used for work on the macro scale.

Ingram¹⁰ absorbs the combustion products of chloro and bromo compounds in an excess of a solution of sodium bisulphite and, after destruction of the excess with hydrogen peroxide and neutralisation of the solution, adds a mercuric oxycyanide reagent and titrates the liberated alkali with standard 0.01N sulphuric acid using a methyl red/methylene blue indicator. The reaction is:



The mercuric oxycyanide reagent is simply prepared by shaking 20 g. of solid with 1 litre of water and filtering into a brown bottle. The solution is neutralised with 0.01N sulphuric acid before use.

Bomb Methods: Bomb methods present rapid and convenient means of determining all the halogens, and, within the past 10 to 15 years, have received considerable attention. There is no doubt that they will ultimately supplant all other methods, as they possess many advantages. Thus, they are extremely rapid and can be used for most types of organic compound (no exceptions have been listed so far). In addition, series determinations can be carried out satisfactorily and results are as accurate as the alternative methods available. These alternative methods generally involve the use of intricate and delicate glass apparatus, which has often to be specially constructed and is easily broken. Furthermore, they require considerable manipulative skill.

First Microbomb Method

The first microbomb method for the determination of the halogens was developed by Elek and Hill¹¹. The method, which is now finding widespread use in modern analytical laboratories, is based on the macro method of Lemp and Broderson¹², where sodium per-

oxide is used to decompose the organic halogen compound. The original design of bomb proved unsatisfactory when applied to micro scale work and an entirely new type of bomb had to be constructed. This consists of a fusion cup, lid, and a clamp to hold the lid in position. The cup has a depth of 25 mm., and an inside diameter of 13 mm., with walls 1.5 mm. thick and with a lip 3 mm. wide on which the lid rests. The lid is fitted with a rubber gasket (lead washers are preferred nowadays) and, when the clamp is screwed down, an airtight seal is made with the cup. The cup has a rounded base provided with an eyelet to facilitate subsequent manipulation. The bomb material is stainless steel and is plated internally with platinum. As the method has not yet found its way into the textbooks of analytical chemistry, details of the experimental procedure may be given.

Thirty mg. of a mixture of pure potassium nitrate and cane sugar (3:1) is placed in the bottom of the bomb cup, and about 5 mg. of the sample is placed on the surface of the mixture. To this is added 1.5 g. of sodium peroxide, and the lid screwed on. The contents are intimately mixed by inverting and shaking the bomb thoroughly. The bomb is now held in a pair of tongs in the hottest part of a good Bunsen flame, care being taken to avoid heating too near the lid. The fusion is complete in about 10 seconds, but a further 5 to 10 seconds is recommended. The bomb is cooled under the tap, wiped, opened and the inner side of the lid washed with a jet of hot distilled water, the washings being collected in a Pyrex test tube (2.5 x 20 cm.).

Two or Three Per Hour

The cup is then inverted in the tube and 10 ml. of hot distilled water added. When the fusion mass has dissolved, the cup is removed by means of a platinum wire inserted through the eyelet in the base, and washed, the washings being added to the solution, which is then cooled in ice. Five ml. of pure concentrated nitric acid are added, the solution filtered into another test tube, and the filtrate treated with 2 ml. of 5 per cent silver nitrate. The test tube is immersed in a boiling water-bath, and after the precipitate of silver halide has coagulated by further heating, it is cooled, filtered and washed (using the well-known Pregl method of microfiltration), dried and weighed. The whole analysis occupies

about 45 minutes, and 2 or 3 analyses can be carried out per hour.

In order to eliminate the preparation, drying and weighing of the filter, as well as the time-consuming filtration, titrimetric methods are now supplanting gravimetric procedures wherever possible. Thus, in the Elek-Hill microbomb procedure for iodine, the halogen is weighed as silver iodide. Elek and Harte¹³ have developed a titrimetric finish which materially reduces the time and labour involved when compared with existing methods. After fusion of the sample according to the method of Elek and Hill, the contents of the bomb are dissolved in 15 to 20 ml. of hot water in a 125 ml. Erlenmeyer flask. The solution and washings are boiled for 30 minutes, till all the peroxide is destroyed, and, after cooling, is made just acid to methyl orange with 3N sulphuric acid to facilitate filtration. Contrary to expectations, no iodine is liberated from this iodate-iodide-acid system, showing that conversion to iodate is virtually complete, or that the amount of acid in excess is too small to liberate iodine.

Solution Filtered

The acid solution is then filtered by suction into a glass-stoppered Erlenmeyer flask and 1 ml. of saturated bromine water added to ensure complete oxidation of iodide to iodate. After 5 minutes, 2-3 drops of formic acid are added to destroy excess bromine followed by 0.2-0.3 g. of potassium iodide. After 5 minutes, the iodine liberated is titrated with 0.01N sodium thiosulphate. A good conversion factor is obtained, 1 ml. of 0.01N thiosulphate being equivalent to 0.2115 mg. of iodine.

Two semimicro bomb methods for the determination of the halogens are of interest. Beamish¹⁴ used a nickel bomb with sodium peroxide fusion. Sufficient sample to give 25 to 40 mg. of silver halide, 30 to 40 mg. of powdered lactose and 1.5 g. of sodium peroxide are thoroughly mixed in the bomb. The bomb is heated in a small flame for 30 seconds, cooled for a few minutes by allowing it to stand in air and then by dropping in a beaker of water. The fusion mass is extracted with water, the solution acidified with nitric acid, silver nitrate added and the precipitate filtered through a Gooch crucible fitted with a disc of filter paper. (When iodine is being determined, any iodate formed is reduced with sulphur dioxide prior to the addition of silver nitrate).

The precipitate is then dried at 140°C. for 25 minutes and weighed.

Commercial Bomb Used

Peel, Clark and Wagner¹⁵ used a commercial bomb of 98 per cent nickel, and worked with samples which gave 20-50 mg. of silver halide. They completed all determinations gravimetrically, as titrimetric methods proved unsatisfactory. The well-known Volhard method, for example, was unsuitable, as the conditions of volume and salt concentration prevailing made necessary a thiocyanate solution stronger than 0.02N; with bromine and iodine, in particular, the effective titres were relatively small, the reproducibility of results being thus impaired. Again, the high salt concentration present militates against the use of adsorption indicators. Electrometric titration methods were not tried, though these would seem to be indicated here. After decomposition of the sample with sodium peroxide in a Parr bomb, the chlorine determination was completed by the Beamish procedure with little modification. When bromine and iodine are present, the alkaline fusion solution is treated with hydrazine sulphate and the whole treated for about an hour on the boiling water-bath. In this way, complete reduction to bromide and iodide occurs, and the determination is completed in the usual manner.

A microbomb method for the determination of organic chlorine has been described by McNevin and Baxley¹⁶. It is based on the classical, but little used, lime fusion procedure, the chief limitation of which is that fusion is carried out in an open glass tube, so that easily volatile samples are liable to escape before reacting with the lime. Again, on the macro scale a large amount of lime is required for each determination, and this is considered to be the main reason for the lack of general popularity of the classical method.

The authors have constructed a bomb of a hollow cylinder of cold-rolled steel, 3 in. long, and 0.5 in. in diameter. The open end is flanged and can be closed by the combination of a threaded collar and plug, a copper disc placed between the plug and the inner flange of the neck of the bomb serving as a seal. For the actual determination, the bomb is one-third filled with specially pure calcium oxide, and enough sample to give more than 8 mg. of silver chloride is added. More calcium oxide is added till

the bomb is two-thirds full, the bomb closed and the bottom two-thirds heated to dull redness over a burner for 20 minutes. After cooling under the water tap the bomb is opened and inverted over a 250 ml. beaker containing 50 ml. of water, and the inside washed well with jets of hot water. The solution is acidified and filtered, and the chloride is precipitated by addition of 1 ml. of 5 per cent silver nitrate, and weighed.

A later paper by McNevin and Brown¹⁷ extends the method to the determination of bromine and iodine. A modification is made to the sealing arrangement of the original bomb, and a novel method for testing for leaks is described, whereby the bomb is filled with solid carbon dioxide and inverted in a beaker of warm water. If bubbles do not appear, the bomb is sufficiently leakproof. In the bromine and iodine determinations, provision is made for the reduction of any bromate or iodide formed during the fusion. The reduction is carried out by adding hydrazine sulphate to the water-suspension of the fusion mass and warming the mixture to 75-80°C. for 5 minutes. The determination is completed gravimetrically. A blank is carried out on the combined reagents.

Stepanow Methods: The classical Stepanow macro method has been successfully adapted to the micro scale by Rauscher¹⁸ who has overcome the difficulties inherent in the original procedure. Thus, decomposition of the compound to ionic halogen was effected with sodium and ethanol, but in many cases was not complete owing to a too rapid reaction ensuing between the sodium and the solvent. Other workers have used other solvents in attempts to obtain a non-competitive reaction between the sodium and the sample, but at the present time, Rauscher's procedure is regarded as the most satisfactory. He uses as solvent a mixture of monoethanolamine (which reacts very slowly with sodium in the cold and which dissolves aliphatic compounds readily), and dioxane to moderate the reaction in the hot state. The dioxane, water-soluble and completely miscible with monoethanolamine, is also useful for bringing aromatic substances into solution.

Simple Reflux Apparatus

Only simple reflux apparatus is required for the determination, and the method lends itself to series analysis. The determination is completed gravimetrically, as the high

concentration of salts present prevent the use of adsorption indicators. The method is briefly as follows: the sample is refluxed in a small round-bottomed Pyrex flask fitted with a finger condenser. A volume of 3-4 ml. of monoethanolamine is added, with enough dioxane to dissolve the sample. One ml. of dioxane should be added, even though the sample dissolves readily. A 0.2 g. piece of sodium metal is added and the mixture brought to a gentle boil. After 30 minutes, during which time more sodium may be added if the original piece dissolves, the reaction is stopped, the flask cooled, and a few drops of water added to decompose the excess sodium. Concentrated nitric acid is added slowly from a burette to neutralise the solution, and an excess of 10 per cent silver nitrate is added dropwise. After coagulation, filtration and weighing are carried out using the well-known Pregl filter stick technique.

Sulphuric Acid Digestion Methods: These methods, while effective, are limited in scope, as only non-volatile compounds can be analysed. Again, only chlorine and bromine can be determined by the procedure. Zacherl and Krainick¹⁹ decomposed the organic halogen compound by digestion at 120°C. with a mixture of potassium dichromate and sulphuric acid using silver chromate as catalyst. Free chlorine or bromine is liberated and is carried over by a stream of air or oxygen into a hydrogen peroxide absorbent containing a known excess of alkali. The free halogen reacts to form halide ions, and the excess alkali is titrated with a standard acid. The reaction may be formulated:—



Apparatus Different

The apparatus of Vieböck²⁰ is somewhat different, although the digestion process is similar. The absorbent is neutral hydrogen peroxide contained in a series of bubblers. The acid produced by reaction of the halogen with the peroxide is titrated directly with standard alkali. The halide ion formed in the titration is then treated with mercuric oxycyanide and the alkali liberated is titrated with standard acid. This latter control titration has the advantage that it is specific for chloride or bromide, whereas the first titration value may include acid from other groupings present in the sample molecule. Thus, acetylated compounds and nitro compounds will liberate acetic acid

and nitrogen oxides respectively on digestion, giving high values for the chlorine or bromine present.

More Convenient Methods

Iodine can be determined by a digestion procedure, though there are other more convenient methods. Shahrokh and Chesbro²¹ digested the sample (containing in this instance less than 0.01 per cent iodine) with a mixture of chromic and sulphuric acids as described by Leipert²². The digest was then reduced by the addition of phosphorous acid and the liberated iodine distilled and trapped in a special apparatus. After oxidation with chlorine and liberation by potassium iodide, the free iodine was determined in the Beckmann quartz spectrophotometer at a wavelength of 353 mμ. if a tungsten lamp was used, and 290 mμ. if an ultraviolet lamp was used.

Miscellaneous: The methods which follow are not so widely used as the others reviewed, but are worthy of mention. Grodsky²³ fused the halogen (chlorine or bromine) compound with metallic potassium in a sealed evacuated Pyrex tube 25 cm. long and of 10 mm. bore. The chloride formed was titrated with silver nitrate using dichlorofluorescein as indicator; the bromide formed was determined on the semimicro scale by a similar procedure, and, if no other acid-forming elements were present, on the micro scale by conversion to iodate in the usual way.

Willard and Thompson²⁴ digested chloro and bromo compounds with fuming sulphuric acid, potassium persulphate and a little copper sulphate. Free halogen is liberated by addition of potassium permanganate and is passed into an alkaline arsenite solution. Finally, the halide ion formed is determined gravimetrically as the silver halide.

The procedure for iodine is identical with that for chlorine and bromine, except that no persulphate is added and an excess of halogen-free 10 per cent hydrogen peroxide is used instead of permanganate.

Miller, Hunt and McBee²⁵ have modified an earlier method of Vaughn and Nieuwland²⁶ and decomposed the halo-compound as follows:—The sample (2-120 mg.), along with some ether is treated with 0.5-1 g. of metallic sodium and 10-15 ml. of liquid ammonia in a glass tube, which is then sealed and shaken till the decomposition is complete at room temperature. The tube

is opened and the halide determined by a modification of the Volhard procedure. Although satisfactory results were obtained, the procedure is lengthy.

Elving and Ligett²⁷ also prefer a metallic sodium or potassium/liquid ammonia decomposition procedure, but here operations are on the macro scale.

A macro scale method for liquid carbon-bonded halogen has been proposed by Benton and Hamill.²⁸ The compound is weighed in a thin-walled sealed glass bulb, transferred to a separating funnel in which all air has been displaced by nitrogen, and an excess of a sodium-naphthalene reagent is added. The funnel is stoppered, the bulb broken, and the contents shaken for 2-3 minutes. The solution is diluted after destruction of the excess reagent, acidified with nitric acid and titrated potentiometrically with 0.1N silver nitrate.

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Kjeldahl Determination Need for Standardisation Stresses

IN a paper by G. Middleton and R. E. Stuckey read at the recent British Pharmaceutical Conference at Harrogate, the need for standardisation in the digestion process in the Kjeldahl determination of nitrogen was emphasised. The method agreed upon said the authors, should be applicable to the widest range of organic compounds possible, particularly in pharmaceutical analysis. They had determined the acid

consumption during the reaction and produced a table of factors for calculating the amount of acid required from the formula:

$$\frac{\text{Acid consumption per gm. of residual formula wt.}}{\text{molecular wt.}} \times \text{factor}$$

By use of this formula the amount of acid, and therefore, of alkali, was reduced to a minimum. Experiments showed that the time of digestion could be decreased to one-half, with a corresponding rise of temperature of 10°C. by increasing the proportion of potassium sulphate. The authors had adopted a ratio of 1 part of anhydrous sulphate by weight to 2 parts of sulphuric acid (1.84) by volume as a standard. Experiments with different catalysts showed a loss of ammonia with selenium catalysts. Using nicotinic acid as a test substance, the efficiency of different catalysts was compared; the addition of dextrose was found to accelerate breakdown of simple pyridine derivatives. Experimental results showed that it was essential to use mercury, e.g., the oxide, as a catalyst.

The authors had applied their method to a selection of simple heterocyclic rings, condensed ring systems, and complex structures such as alkaloids.

Discussion

In the discussion which followed, Dr. G. Foster remarked that he had never had any trouble with selenium as a catalyst, and asked why mercury should be better than any other. He also wondered what happened to the nitrogen when heating was carried out with selenium. Dr. Stuckey in reply said that the catalyst chosen was the one which could be used for the greatest number of compounds. Selenium and copper could also be used provided that the operator had experience of the method. He thought that the loss of ammonia was due to partial oxidation, rather than to thermal decomposition. Asked by Dr. D. C. Garrett whether the authors had systematically considered the time factor after the clearing of the digestion mixture, Dr. Stuckey said that it had been considered in detail. Prolonged heating would cause ammonia to be lost even when no catalyst was present. It had been decided therefore to reduce the heating time by using the most efficient catalyst.

Dust Incidence in the Sulphate Pulp Industry

by S. C. BLACKTIN, Ph.D., M.Sc.

SPACE will not here permit an exhaustive classification of the incidence of dust in even one function of human activities, viz., the industrial function. But, nevertheless, marked, if incomplete distinctions, can be drawn between the various modes of dust incidence in some great industrial spheres. Consider the following distinctions, viz. (1) Dust, relatively valueless, of very restricted incidence, possibly dangerous, but attracting comparatively small attention; as may be the case in glass manufacture and fashioning. (2) Dust, as in (1), but of known and even dreaded danger, hence demanding full and constant attention—and sometimes full suppression—as in masonry of sandstones. (3) Dust in so small incidence as to be, normally, negligible both as regards health and nuisance, yet of most vital concern to the industrial producer, as in photographic-emulsion manufacture. (4) Dust produced in such large amount, and cumulatively, by the principal industrial operation that it is a vast nuisance and also a dominant threat to both health and safety while yet relatively low in salvage value, as in much coal mining. (5) Dust which cannot be a nuisance since it is all valuable as the end product of the industry producing it, but which must nevertheless constitute a nuisance in many of the operations which yield it as a product, as well as a danger sometimes to the producers in contact with it, as in cement manufacture. (6) Dust which is very dangerous to health, but more likely to reduce than increase danger from explosion, as in asbestos manufacture.

Exceptional Type

There is, however, a very exceptional type of industrial dust, in that, while it may be neither a nuisance nor a danger because of dispersion throughout the industrial atmosphere, neither is it, *directly*, a valuable by-product of the chief operation. But it arises as very valuable for salvage as a result of the salvaging of an earlier by-product of the main operation. This dust arises in the paper-making (sulphate pulp) industry, and the quantitative extent of its production is as great as its remoteness from

the main process. It is proposed to devote this article to this particular industrial dust output, which, if not the only dust produced is certainly the most valuable one to be salvaged in this industry.

Multifarious Uses

Even in these days of plastic substitutes it needs no emphasis to bring home the multifarious extent and uses of all the various forms and qualities of wrapping papers and their modifications, for all sorts and conditions of commodities all over the world. While, therefore, the production of this type of paper is enormous, amounting with other types to a demand of over 40 million tons of wood per annum—yielding about 15 million tons of wood pulp; even that is but about 5 per cent of the wood cut per annum in Europe and North America, while fuel and construction work consume the other 95 per cent. Though the larger proportion of that cut is replaced by annual growth there is also a similar amount lost through forest fires.¹

The sulphate pulp produced by the process to which it gives its name derives its title from the fact that the raw materials are boiled in a solution of sodium sulphate, instead of in caustic soda as in the soda process. As would be expected the sulphate process is not so drastic as the older one, which probably accounts for the stronger fibre resulting from the sulphate process, with a consequent greater provision of the toughness required in wrapping papers. The yield of the sulphate process is also greater, probably from the same cause.

The spent liquor or residues from the boiling processes are conducted to furnaces or rotary incinerators or the like, where such sulphate-cooking residues are calcined to recover the soda compounds in the form of 'smelts'. Organic materials partly burned, sodium sulphate in a very fine state of division, and a proportion of soda ash are fumed off. It will be clear that the most valuable portion of this dispersion for re-use in this industry, and arising from the main body of sodium sulphate recovery obtained from the furnaces, is the finely-divided dispersed

phase of sodium sulphate. It is just this most valuable portion, however, which is most difficult of all the components—and in an absolute sense extremely difficult—to salvage completely. This is partly due to its extreme fineness, partly to the further presence of acidic gases which, along with water vapour, constitute the dispersion medium of the dispersion. The organic residues and the sodium carbonate being removable with much less difficulty, the chief dispersion to be salvaged is that of a disperse phase of sodium sulphate in a medium of hot acidic gases and water vapour. This dispersion is not, of course, dispersed throughout the industrial atmosphere as in the case of the dust contaminants, valuable or not, in many industries; but is maintained within a conduit system into which it is fed from hoods maintained over the recovery furnaces.

Chemically Produced

Clearly this industry presents a case of a dust production brought about by chemical means, as distinct from those industries in which the dust is produced by mechanical means.² The coal mining, asbestos, and masonry industries mentioned above are clearly, on the other hand, just as exclusively, mechanical dust producers. It, therefore, is of interest shortly to consider the mode of formation of the sodium sulphate dust in such paper manufacture. For it is much more complex than obtains with mechanical dust producers whose *modus operandi* is more or less self evident.

The sodium sulphate particles thus, as such, chemically produced are known in some cases as being, and are probably so in all cases, as of diameter 1 micron or less. They are, therefore, of similar size order to the particles constituting sulphuric acid mist from concentrators.³ No wonder they are difficult to separate from their parent medium! A classification by particle size of dusts, smokes, and fumes, shows dusts to be those with particle sizes greater than 0.1 micron which are formed by disintegration, for below that size limit Brownian movement of particles exceeds their gravitational movement. Our sodium sulphate particles of 1 micron or less are, therefore, clearly partially and probably wholly, dust particles as to size. As clearly, however, being chemically and not mechanically formed, they are built up from immediately preceding states not by disintegration but by its

reverse, i.e., aggregation or accretion. They are, as it were formed by particulate 'growth' and not be particulate, 'decay'. The 'growth' here considered is, of course, that inorganic 'growth' of accretion as distinct from that real, organic growth of intussusception. A classification taking account of both these natural, if opposed modes of formation (that is 'growth' and 'decay') and thus also reducing the critical importance imparted to particle-size limits of differentiation when, in nature, particle-size limits in most dispersions are continuous and transitional rather than sharp, has however been advanced.⁴ So that our sulphate particles are certainly dust particles after formation.

Mode of formation, however, is the crux of the chemically formed dusts, for while with the mechanically formed, formation is from larger units, the formation from immediately smaller units necessarily involves the transition from smoke and fume as regards the chemically formed. The continuing life history of smoke and fume is one of agglomeration of smaller to form larger units, and it is claimed that, in this macroscopic sense, a natural termination is put to this size increase by agglomeration when the agglomerate (smoke or fume) turns the peak and passes naturally into dust characterised by onset of the reverse process of disintegration to which cessation from agglomeration automatically and naturally, submits it.⁴ What will determine the peak particles size value of agglomerates? Undoubtedly the spatial condition limits, and the temperatures at which the smoke and fume are maintained during and after formation, will be governing factors. And in this case of sodium sulphate particulation the spatial restrictions and the maintenance of the dust formed at a temperature of 450 to 500°F. results in an agglomeration limit of one micron or less to the precedent smoke and fume.

Size Considerations

It is not known whether this limit size of one micron is also the peak agglomeration size during this, quick, hot, colloidal transmutation. Also other factors are likely to influence the resultant dust particle size, such as the electrical stresses between the respective disperse phases and dispersion media; between particles of different size; between particles of sodium sulphate, carbon, and

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sodium carbonate; and the variation of such electrical stresses due to the known presence of much moisture.⁵

In a modern plant the magnitude of production of the dispersion may be at the continuous rate of 350 to 400 cubic feet per minute per ton of sulphate pulp produced. So that in a mill with a tonnage of, say, 200, the dispersion would be formed at the rate of 70,000 to 80,000 cubic feet per minute. This is sufficient, each minute continuously to occupy at N.T.P., about 80 normal-sized living rooms—a vast output. With the upper limit for the dispersed sulphate therein of one micron diameter per particle, the volume of each particle supposed spherical will be 5×10^{-10} cubic mm. The amount per thousand cubic feet of dispersion of sodium sulphate dispersed may be from 1 to 2½ lb. Thus, if the density of the amorphous sodium sulphate is, say, 2.67, the number of sulphate particles per 1,000 cubic feet is from $453/(5 \times 10^{-10}) \times 2.67 = 340$ million million; to $1020/(5 \times 10^{-10}) \times 2.67$, say 765 million million. And the proportion of each 1,000 cubic feet occupied by solid particles will thus be from $453/2.67$ to $1020/2.67$, say from 170 to 382 cubic centimetres only. The space per 1,000 cubic feet occupied by the dispersion gases and water vapour in the heaviest dispersion will thus remain appreciably unaltered at 999.985 cubic feet. Nevertheless, if the particles are assumed evenly distributed throughout the dispersion, there will thus be one particle of one micron diameter in each 0.0008 cubic mm., of lightest dispersion (1 lb. per 1,000 cubic feet) and in each 0.00035 cu. mm., of heaviest dispersion.

Dispersions Heavy

Although, as the particle has volume 5×10^{-10} cu. mm., this gives a ratio of volume occupied by sulphate to volume occupied by gases (dispersion medium) of only 1:160,000 up to 1:64,000, it must be realised that this extremely rare volume-occupation by particulate matter nevertheless represents extremely heavy dispersions of from 12,250,000 to nearly 30,000,000 particles in each cubic centimetre of gaseous dispersion. It must also be realised that this apparent incongruity between volume and number arises from the fact of the minute volume of particles of one micron diameter. It also emphasises most strikingly one of the most important fundamen-

tals which account for the recognition of a distinct colloidal state of matter. That is, the huge increases in exposed surfaces, as exemplified by the division into 340 million million particles, each with a separate discrete surface within a gaseous cell 64,000 to 160,000 times its own volume, of each 1 lb. of sodium sulphate.

The heaviness of the dispersions so formed of from 12,250,000 to 30,000,000 particles per c.c., is further indicated by the realisation that, of the many instruments devised to determine particle dispersions by counting,⁶ only one—the Electrotor Meter—is endowed to attempt *in situ* direct counts of dispersions of such magnitude. It should be added, that to deal with such determinations, the Electrotor Meter does not in any way lack ability to deal also with the lighter dispersions amenable to the various other counters, even down to, say, 100 particles per c.c., or less.

Other Materials Present

The presence of acidic gases and water vapour; of organic material and sodium carbonate; in addition to sodium sulphate of from 1 lb. to 2½ lb. per 1,000 cubic feet, have already been noted. The gases are chiefly hydrogen sulphide, carbonic acid, and sulphur dioxide in respective amounts which may reach one-hundredth, one-eighth, and one eight-hundredth of the total volume of dispersion. The proportion of water vapour present is considerable, its occurrence being due both to the combustion of organic materials and to the evaporation of some water.

If the cost of sodium sulphate be taken as, say, sixpence per lb., it is easy to see that a plant yielding 80,000 cubic feet per minute will, in a continuous run of 24 hours, build up dispersions at a cost in wastage of from £2,880 (1 lb. per 1,000 cubic feet) to £6,480, for the contained sodium sulphate only. This makes it obvious, even at a cost considerably less than sixpence per lb., which may be usual, that the application of maximum ingenuity in salving as much sodium sulphate as possible from the dispersions, is warranted. Perhaps the greatest problem calling for solution by such ingenuity is that introduced by the presence of so much moisture in conjunction with acid gases.

Some particulate matter is removable with relative ease, and this consists of sodium carbonate and organic matter, which can be

abstracted before the dispersion proper of this article, viz., the sodium sulphate, comes to be dealt with. This partial removal seems to leave intact, however, the larger proportion if not all of the moisture and acidic gases as well as the dispersed sodium sulphate. Thus, any scheme of special technique adopted for the removal of the particulate sodium sulphate must either (a) operate at temperatures higher than, say, 100°C., to preclude the condensation of the large content of moisture, or (b) be built from materials which are not dissolved or corroded by acid solutions of the gases in the condensed moisture. And, of course, even if (a) can be achieved the materials will have to be such as are resistant to hot acid gases and steam.

Effluent Effects

Whether this maximum dust content of sodium sulphate can be salvaged or not, there is a large dust problem to be overcome excepting only if it can be salvaged in manner (b) above. For if the material cannot be salvaged at all there exists the continuing drain of the large financial losses; while if the sodium sulphate can be salvaged by method (a) above there remains a serious problem, not indeed of direct financial loss, but of potentially direct, possible or probable, ill effects as to health and soil productivity in the region surrounding the paper mill, and thus of indirect financial loss. The magnitude of this latter loss is at once obvious when it is recollected, as previously shown, that the amount of sodium sulphate by volume in the dispersion, is negligible. Thus stack gases to the extent of 115 million cubic feet may be poured over the locality surrounding the mill in each 24 hours' continuous running. The significance of this output for erosion of building fabric—containing as it may over 12 per cent of acid gases—soil acidification, poisoning of the atmosphere, etc., is better grasped when it is put in the form of approximately 1 square mile of acidified gases, 4 to 5 feet deep, during each day (24 hours). The conclusion is, therefore, unavoidable that while the salvaging of the sodium sulphate is the problem of immediate financial importance, even when and if this is fully accomplished, a very large and serious problem still remains as to the trapping or disposal of the dispersion medium of the dispersions if the more difficult method of particle salvaging,

i.e., its accomplishment despite condensation of moisture content, has not been achieved.

Apart from the difficulties of the acid and moisture contents of the dispersions, there is further the difficulty due to the high particulate proportion per 1,000 cubic feet of sodium sulphate dispersed resulting from its very fine state of division. This entails the huge losses of the order referred to, if none of the particulate matter is salvaged; and still very considerable losses even if an amount is salvaged which, in many other dispersion-salvage industries could be regarded as completely satisfactory. Thus, if even as much as 80 per cent of the particulate sodium sulphate were salvaged by any or all systems or techniques available for this purpose, the loss in sodium sulphate alone might still be of the order of from £572 to £1,287 for each 24 hours' continuous running, an enormous loss to any process.

Thus it is quite feasible that even the ultimate 10 per cent of sodium sulphate lost in an otherwise—if attainable—very efficient salvaging of 90 per cent might be by far the most important 10 per cent though distinctly unattainable. For this ultimate 10 per cent, representing such large monetary value, might easily make that vital distinction in expenditure which, if avoidable, would have converted a loss on running a mill into a profit. The emphasis is, therefore, not less on the salvaging of the sodium sulphate to the utmost limit, than it is on salvaging a large proportion of the sulphate and which is attainable by already recognised, if costly, methods. And the greatest difficulty of all is doubtless that of discovering a method or technique which can still operate effectively and cheaply beyond the limit of effectiveness of already applicable methods.

Available Methods of Recovery

1. *Cyclone Separation*.—This method may be brought into service, and as its characteristics are fairly well known, it need only be stated that it is anything but a complete answer to the separation of particles as small as one micron. Even if its maximum efficiency reaches 80 per cent by weight removal of particles, this cannot be depended upon for particles of 10 micron or less owing to the difficulty of suddenly producing a still air zone. Its operation must be indeterminately with particles of one micron.

2. *Electrostatic Precipitation*.—The maintenance cost of plant of this description is considerable in addition to the initial cost of

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the precipitators, which is not small. Though it may have a higher efficiency than cyclone separation, it is necessary to consider carefully the benefit obtained by salving against the cost and maintenance of the plant required to achieve it.

3. *Scrubbing Towers*.—The efficiency of particle separation of this method is erratic and may quickly vary, without apparent good cause, from say 50 per cent to not higher than 75 per cent. The packing of the towers, of say about 100 cubic feet capacity, is expensive. For instance, in sulphate pulp production it may reach about £30 per ton of production thus involving of the order of £6,000 for a mill producing, for example, 200 tons of pulp and about 75,000 cubic feet, of sulphate dispersion per minute. Additionally, the operating expense of such towers is considerable.

It seems clear that future advance should take the form of salving the last fraction of dust from dispersions, at a cost economic contrasted with that of those separation methods already available for abstracting similar-sized fractions within the limits of their maximum efficiencies. For the weakness of available separation systems is either (a) inability to extract the vital, last fractions, or (b) the great expense of making some approach to (a); or (c) both these shortcomings. Doubtless this has application quite generally whether it is a case of salving appreciable copper and arsenic from six to 10 tons per day of dust from copper smelting works; 40 to 100 lb. of potassium per million cubic feet of gas from iron blast furnaces and containing up to 0.45 gm. of dust per cubic feet; 20 to 30 tons of dust per day from non-ferrous metallurgical smokes emitted at, perhaps, 1,000,000 cubic feet per minute; and from the 500,000 to 600,000 cubic feet of gases per ton of coal burned; the 10 tons of sodium sulphate per day emitted in the dispersions from a sulphate pulp mill not of the largest; or numerous other far-flung processes and instances. Some progress has been made towards that goal, and there is hope of its eventual accomplishment.

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Obituary

MR. W. B. PARKER

We regret to announce the death on 12 October of MR. W. B. PARKER, F.I.C., who had retired from the British Thomson-Houston Company in 1946, after 44 years' service. Mr. Parker was the company's chief chemist and metallurgist from 1902 until 1943, when he was appointed BTH consultant chemist and metallurgist.

Mr. Parker, who was 77 years of age, was born in Smethwick, and at the age of 16 he started seven years' employment with The Patent Borax Company. During this time he attended evening classes in chemistry and metallurgy at the Birmingham Central Municipal Technical School, and in 1897 he won by public examination the Priestley Scholarship. This enabled him to enter Mason's University College (subsequently Birmingham University), where he studied chemistry, physics, metallurgy, and mathematics.

Joined BTH

In 1902, he joined BTH as chief chemist and metallurgist, and became an Associate of the Institute of Chemists (A.I.C.) by examination in 1902 and a Fellow of the Institute (F.I.C.) in 1905. He became a Fellow of the Chemical Society of Great Britain (F.C.S.) in 1925, he was one of the first members of the British Institute of Foundrymen (1908) also of the Institute of Metals (1909). He became a member of the Society of Chemical Industry (1902), a member of the Paint and Varnish Society—now the Oil and Colour Chemists' Association (1909), and also a member of the Electro-depositors Technical Society (1925). He was also a member of the American Chemical Society, and a member of the American Society of Metals.

Founder of BCIRA

Acting for BTH, he was one of the first councillors of the founders of the British Cast Iron Research Association, and was an active member of many of the committees of the British Standards Institution, also of the British Electrical and Allied Industries Research Association (E.R.A.). In connection with these committees, and particularly the latter, he conducted numerous researches on insulating and lubricating oils, shellac, mica, and many metallic substances, etc.

Society of Leather Trades Chemists

Northampton Group Hears Professor Burton

A MEETING of the Northampton Group of the Society of Leather Trades Chemists was held on Thursday, 11 October, at the College of Technology, Northampton, with Mr. F. W. Hancock in the chair.

The speaker for the afternoon was Professor Donald Burton, M.B.E., D.Sc., who gave an address on 'The Effects of Salts in Vegetable Tanning, Chrome Tanning and Dyeing.'

Salts Classified

Professor Burton commenced by pointing out that neutral salts were formerly regarded as the salts formed on neutralising acids but Procter realised that some of them were alkaline. He suggested that chrome and vegetable tanners should divide salts into classes: (1) Salts of Strong Acids, which include the so-called 'neutral salts' such as chlorides and sulphates and (2) Salts of Weak Acids, which include masking salts and buffer salts. Reference was made to the Lepetit-Dollfus-Gansser process in 1896. Procter's 1903 theory that salts of weak acids mellow vegetable tanning liquors and Bennett's work in 1909 and 1917 on the effects of lyotropic salts in vegetable and chrome tanning.

Professor Burton suggested that there are similarities between the two processes, which should be emphasised. The fundamental difference is that the acids and salts react with the chrome tanning compounds with subsequent slow chemical changes. There is no exact counterpart of olation in vegetable tanning but evidence that vegetable tannins can combine together and, also, with some acids was given. This was followed by a description of the effects of the salts present in vegetable and chrome liquors on the structural cohesion of the collagen fibre and the degree of splitting into fibrils, the swelling and the affinity of the anions for the collagen. Sufficient addition of salts of weak acids can bring both the tannages to a standstill. Salts of dibasic and polybasic organic acids may have interesting effects on the properties of vegetable tanned leather. A useful control in chrome tanning might be a figure corresponding to the acidity of pH 5.8 in the

vegetable process. The swelling in both tannages is determined by the pH value and the lyotropic effects of the salts present. Chlorides, sulphates and salts of weak acids mellow the liquors. The counterpart of the precipitation point value is the Procter Lime-Water Figure. The average sizes and shapes of the tanning particles are important. Chlorides and sulphates reduce the rate of tan fixation in both tannages and the pelt can take up a strong acid when weak acids and salts of strong acids are present. The shrinkage temperature of vegetable leather may be affected by the nature of the combined acid as well as by the amount and kind of free acid present as in the case of chrome leather.

Dyeing With Acid Dyestuffs

The dyeing of vegetable tanned leather with acid dyestuffs was discussed at length. These are usually salts of sulphonic acids but some may be salts of other acids. Diluents, such as salts, may influence their dyeing properties very considerably. The penetrating power, the depth of shade and the fastness are probably determined by the pK_a values of the acids, the size of the particles and the kinds and amounts of the acids and salts present. The effects of adding salts of weak acids, salts of strong acids, weak acids, weak acids plus salts of strong acids, weak acids plus salts of weak acids, strong acids, strong acids plus salts of strong acids, and strong acids plus salts of weak acids are being investigated in the Leeds Leather Industries' Department using dyestuffs containing acids of known pK_a values. The theory of dyeing was discussed in relation to published work and practical procedure.

After an interesting discussion, a hearty vote of thanks to the speaker was proposed by Mr. John Mudd and carried unanimously.

Natal's First Cement Factory

Work is to be resumed shortly on the first kiln of Natal's first cement factory at Port Shepstone. When this is completed output will be about 65,000 tons a year.

Adsorption Processes in Refining

Variety of Separations Possible

THE unit operation of adsorption is not a newcomer to the petroleum industry. It has been used for many years in the treatment of cracked gasolines (for example in the Gray process) and for decolorisation purposes (as in Filtrol fractionation technique). Other important applications range from wax and lube oil decolorisation to the refining of used crank-case oil, from drying of solvent naphthas to treating acid-treated oils.

In all of these instances, the objectionable impurities are a relatively small percentage of the total charge stock. Removed as sorbate, no attempt is made to recover these impurities which are considered expendable.

One of the important developments of post-war refinery practice has been the use of adsorption processes for the fractionation of feedstock constituents into separately recoverable streams of product. At the same time, the technique of adsorption has been perfected to the point where it can remove specific impurities, such as hydrogen sulphide, at a cost which is competitive with more established chemical methods.

New Hypersorber

Perhaps the most striking development in this direction has been the hypersorber of the Union Oil Company which is now being employed commercially in a number of refinery and chemical installations. This continuous countercurrent method for the adsorptive fractionation of gaseous hydrocarbons has been developed to the point where it can serve such diverse uses as the separation of ethylene from cracker gases, the recovery of LP gases from natural gas, the removal of nitrogen from gaseous hydrocarbons, the recovery of acetylene from the products of high-temperature cracking or partial oxidation of natural gas.

Equally important are the potentials offered by the hypersorptive removal of hydrogen sulphide from natural gas, and the purification of synthesis gas (that is, mixtures of carbon monoxide and hydrogen), containing carbon disulphide and carbonyl sulphide (COS) in trace quantities.

Continuous countercurrent adsorption is economically the soundest approach

to the separation of hydrogen from methane and a hypersorber is serving this function in the hydrogen cyanide plant of Rohm and Hass Company at Deer Park, Texas. A plant now being erected by Standard Oil Company of California will use adsorptive methods for the fractionation of refinery gas into an overhead fraction containing methane and ethane, and a bottoms cut of C₄ hydrocarbons. Propane and propylene will be removed as a sidestream from the hypersorber. The adsorption agent in each of these cases is a relatively inexpensive grade of activated charcoal.

Adsorption by Silica Gel

Adsorption processes for the commercial separation of liquid hydrocarbons are of even more recent vintage than hypersorption (which, at the age of three years, is already a standard refinery process). Now under construction is a plant of Sun Oil Company at Marcus Hook, Pa., where silica gel will serve to separate aromatics from associated hydrocarbons, using a feedstock derived from an aromatising 'Houdriforming' operation. Available data on Sun Oil's version of fractionation by silica gel adsorption are scant. Studies on a similar process have, however, been carried out by California Research Corporation.

The operation involves multiple fixed beds of a suitable grade of silica gel or other adsorptive material. Each column undergoes, in the course of a cycle, the following successive steps: 1) Raffinate refining, (2) extract enriching, (3) hot stripping, and (4) cooling. In the course of this cycle, the aromatic contents of the feedstock are first adsorbed on the gel. During the same phase of the cycle, the aromatic contained in a recycle stripping stream has served to regenerate spent gel at elevated temperatures (that is at conditions most favourable for desorption). The aliphatic portion of the stream issuing from the adsorbent cases is forwarded to distillation.

Saturated adsorbent is regenerated by a stream of low-boiling hydrocarbons at elevated temperatures. A portion of the exit stream is recycled to the first stage of

the adsorption cycle. The remainder of the elutriate is sent to distillation for separation into aromatics in the bottoms and an overhead product which can be recycled to the process as stripping medium.

The cyclic process for the adsorptive separation of hydrocarbons is highly efficient as can be seen from the following data reported for the refining of a hydroforming naphtha:—

Stock	Hydro- formed Naphtha charged	Raffinate Product	Extract Product
Aromatics, vol. per per cent.	35.8	1	99
Gravity °API	50.9	60.7	31.2
Aniline point, °F . .	69	137	—88

At present the adsorptive fractionation of liquid hydrocarbons is still being carried out in fixed-bed cases. In view of the short cycle time (15 minutes to 2 hours), considerable fractionator space is wasted in this operating method. At the same time, this approach calls for expensive cycle control equipment and relatively high maintenance.

Adaptation Approach

Adsorptive processes are, however, similar in operating character to cyclical catalytic processes. Consequently, attempts are being made to adapt the engineering features of Thermoform Catalytic Cracking and similar processes to adsorptive fractionation. So far, difficulties encountered on a pilot plant scale have prevented the commercialisation of this interesting approach.

Principal obstacles to the application of TCC methods to adsorptive fractionation include: severe attrition losses of the friable adsorbents; and inability to combine the need for small resistance to diffusion (which calls for small particle size) with the requirements for a heavy adsorbent particle which are set by the tendency of the upward-moving liquid to lift the settling particle. As was the case in catalytic cracking processes, the use of continuous countercurrent adsorptive fractionation processes for liquid will, therefore, of necessity hinge on the development of properly designed adsorbents.

A number of adsorptive fractionation processes are still in the laboratory stage. The method is already an important tool in the analysis of petroleum products, but it shows important potentials for the commercial separation of petroleum fractions.

Specificity of adsorption increases with boiling point and with the degree of unsaturation of the sorbate. Advantage can


be taken of the affinity of butadiene for various sorbents to recover it from cracker gases. The problem has been studied by Taylor and Bonilla for the purpose of recovering butadiene from the vent gases of GR-S synthetic rubber plants. These workers were able to adsorb this diene on zinc-chloride-impregnated charcoal up to a weight of 60 per cent of the sorbent.

Activated carbon has been shown to exhibit a marked preference for straight-chain rather than branched-chain paraffins. Thus, Hibshman has been able to absorb *n*-pentane in preference to *iso*-octane in spite of the normally greater affinity of adsorbents for higher-boiling hydrocarbons. Other adsorbents, such as activated alumina, magnesia, silica gel, and so on, showed an adsorption tendency which is contrary to that of activated charcoal for the system *n*-heptane-*iso*-octane. By proper choice and formulation of the adsorption agent, a variety of different separation processes, therefore, becomes possible.

In recent years, emphasis has been lent to adsorptive processes for the removal of sulphur compounds. The use of alkali-impregnated charcoal has been found to desulphurise petroleum effectively. Similarly, it has been found possible to concentrate sulphur compounds by percolation over silica gel. There is evidence that most sulphur compounds (excepting thiophene) can be separated from hydrocarbons by this approach. Techniques available at present are still inefficient from a thermal point of view (that is they call for high steam consumption for regeneration). Silica gel percolation is, therefore, not considered an economic approach to commercial recovery of mercaptans at this time. As a means of removing nuisance mercaptan sulphur, the combination chemical and adsorptive method of percolation through alkali-impregnated charcoal appears promising.

Separation Techniques

The increasing dependence of chemical manufacturers on petroleum-derived raw material acts as a strong incentive to the refiner to incorporate techniques into his plant which permit the separation of pure chemicals from his complex mixture of hydrocarbons. Unquestionably, adsorption offers possibilities in this direction which cannot be matched by any of the other unit operations in common usage to-day.



The Chemist's Bookshelf

PLASTICS AND BUILDING. By E. F. Mactaggart and H. H. Chambers. Sir Isaac Pitman & Sons, Ltd., London. 1951. Pp. 181; 16 colour photographs. 60s.

This book is intended as an introduction to the subject of 'plastics', to be read by the architect, builder and industrial designer. It is not, in any sense, a chemical text book and its value can only be assessed by considering how far the intentions of familiarising the building trade with the possibilities and drawbacks of synthetic constructional materials are realised. One can even make a case against the production of such a book and claim that the architect and designer should state their requirements to the chemist who will then produce the required material. The American concept of 'tailored' molecules favours this point of view, but it seems fairly obvious that a great deal of time and fruitless discussion can be saved if the building technician has some idea of the scope and limitations of what are loosely described as 'plastics'.

The authors explain the concept of molecular structure simply but elegantly and they are greatly assisted by the excellent diagrams produced by the Isotype Institute. These diagrams are particularly clear and this kind of representation could with advantage be made standard in elementary textbooks. In succeeding chapters the whole field of synthetic resins and plastic materials is surveyed in a general fashion, the synthetic elastomers and fibres being included.

The explanation and discussion is everywhere related to the economic aspects of plastics development and use and this gives the reader some perspective. In particular the authors stress the value of a petroleum refining industry and a source of cheap power to the plastics manufacturers. In Britain we have not had until recently either of these advantages. The Severn Barrage plan which could have provided cheap electricity was turned down in the 'thirties' and will now probably never be built, but on the other hand the opening of the new refinery recently promises a fresh source of

raw materials. The authors' survey of modern developments does not appear very complete nor their analysis of future trends particularly penetrating, and this is perhaps unfortunate as it should have been, on the whole, a stimulating chapter for the progressive designer and architect. On the other hand the book contains an amazing amount of technological information concerning the methods of use and fabrication of all kinds of plastics.—J.R.M.

GERMAN-ENGLISH CHEMICAL TERMINOLOGY. Revised 2nd Edition. By Alexander King and Hans Fromherz. London: George Allen & Unwin, Ltd. 1951. Pp. XV + 361. Price 25s.

This book is composed on a rather new and original line as the coherent text represents an introduction to chemistry in English and German. It is a comprehensive survey not involved with highly technical language, not intended as a scientific work nor as an encyclopaedia on the subject, but more as a handy volume which will provide for persons somehow interested in chemistry, or the average reader, an acquaintanceship with the ever growing field of chemistry. The edition contains almost 5,000 chemical and technical expressions in the text and in the indices. The book's five parts deal with elementary, inorganic, organic and physical chemistry and with modern ideas of the structure of matter. The authors have drawn up many sources of information which would be difficult for one to locate who is not familiar in the field of chemistry. They have thus compiled an engaging and informative book for which there has been a need to make known the correct uses of chemical expressions in both languages while working in both English and German laboratories. The book will help students, research workers and in general readers of chemical literature. Appendices of the book contain a table of atomic weights, pertinent mathematical expressions and usual abbreviations and conclude with a bilingual index.—F.N.

HOME

New Tar Acid Refinery

Monsanto Chemicals, Ltd., and Midland Tar Distillers, Ltd., jointly announce that a tar acid refinery is in the course of erection at the new works of Midlands Tar Distillers, Ltd., at Four Ashes, near Wolverhampton. In due course the crude tar acids produced by Midlands Tar Distillers, Ltd., will be refined at the new plant instead of at Ruabon.

Key Industry Duty

The Treasury have made an Order under Section 10 (5) of the Finance Act, 1926, exempting the following articles from Key Industry Duty for the period beginning 24 October, 1951, to 19 February, 1952:—*m*-chloroaniline ethylene chlorohydrin, ethyl sodium oxalacetate, manganese metal of a purity exceeding 99½ per cent, di-methionine, photographic film base dutiable only by reason of containing cellulose acetate as an ingredient, trichloroethylene, zinc di-ethylidithiocarbamate.

The Order is the Safeguarding of Industries (Exemption) (No. 11) Order, 1951, and is published as Statutory Instruments 1951 No. 1839. Copies may be obtained (price 2d. net by post 3½d.) from His Majesty's Stationery Office.

Triphosphate Factory Moved

The steel skeleton of a chemical factory has been moved by rail from Windermere to Kirkby Trading Estate, near Liverpool. Girders, forming a steel web to be completed in January, are 300 ft. long, 250 ft. wide, and 70 ft. high. The factory, for Albright & Wilson, Ltd., will be one of the biggest single-span buildings in the country, and will employ hundreds of people in the production of sodium triphosphate. When the former flying boat factory was dismantled during the summer, railway and building engineers made elaborate plans to take the 1,500 tons of steel on its 80-mile journey to Liverpool. Every girder was numbered and ticketed (the longest section was 45 ft.), and the equipment was transferred to its new base in three weeks. Erection of the girders began last month. Ancillary buildings, including two 134-ft exhausting towers, and the single-span structure should be completed by the end of 1952.

Third Packaging Exhibition

It is announced by the Institute of Packaging and the organisers (Provincial Exhibitions, Ltd.) that the third National Packaging Exhibition will be held in London at Olympia, during the ten days 20-30 January, 1953. Despite the success of the first two exhibitions, particularly that held in London last February, it has been decided to keep the display biennial, as shortages of many packaging materials, among other reasons, renders an annual show, for the time being, impracticable.

To Find American Market

Mr. John H. Lawrence, managing director of Jenolite, Ltd., this month leaves for America to negotiate the establishment of Jenolite processes on the American markets. This move represents the climax of the Jenolite expansion programme which began in 1947. Before that, Jenolite was confined to Britain, the country of its conception in 1942.

With the fulfilment of American and Canadian negotiations Mr. Lawrence will have accomplished his goal of world representation (excluding, of course, Iron Curtain territories) for, since the first Swedish agency was set up in 1947, he has built a world-wide network of Jenolite representation. To-day, 48 agencies operate.

Chemical Engineering Scheme

The Ministry of Education announced on Tuesday the introduction of a Higher National Scheme in Chemical Engineering. The scheme, which will become operative for the educational year 1951/52, has been arranged by the Ministry in conjunction with the Institution of Chemical Engineers. The arrangements and conditions for the award of Higher Certificates in Chemical Engineering are described in Rules 122 (H.M. Stationery Office, price 4d. net).

Notes on the arrangement of courses for the Higher Certificate in Chemical Engineering are given in a brochure published by the Institution of Chemical Engineers entitled 'Scheme for a Part-Time Course in Chemical Engineering,' copies of which may be obtained on application to the Institution, 56 Victoria Street, Westminster, S.W.1.

PERSONAL

PROFESSOR ARNE TISELIUS, professor of physical chemistry, Upsala University and 1948 Nobel Prizewinner, has been elected president of the International Union of Pure and Applied Chemistry. PROFESSOR E. C. DODDS, director of the Courtauld Institute of Biochemistry, becomes vice-president. DR. E. W. R. STEACIE, director of the Division of Chemistry, National Research Council, Ottawa, has been appointed president of the Physical Chemistry section of the union.

MR. ADAM TAIT, head chemist with William Younger & Co., Ltd., brewers, Edinburgh, has retired from active work after 44 years of service with the firm. He will continue to act as consultant. His successor as head chemist is MR. L. FLETCHER.

At the annual general meeting of the Widnes Foundry & Engineering Co., Ltd., held recently, MR. RALPH CREDLAND, assistant managing director of the company for the past four years, was appointed joint managing director. Widnes Foundry is one of the Thos. W. Ward group of companies.

Lansing Bagnall have recently announced that MR. A. R. WRIGHT has been elected to the board of directors. Mr. Wright has been associated with the company for ten years, and he is well-known by all those interested in materials handling. Since Lansing Bagnall's move to Basingstoke—which also necessitated his moving his wife and family to Hartley Wintney—he has contributed very largely to the work entailed in establishing the firm in their new surroundings.

SIR HUBERT HOULDSWORTH, chairman of the National Coal Board, was the principal guest at the autumn dinner of the Institute of Fuel held at the Connaught Rooms, London, on 18 October. The president, DR. B. E. FOXWELL, presided, and there were about 700 guests.

MR. CHALMER GATLIN KIRKBRIDE, vice-president and director of Houdry Process Corp., has been chosen to receive the 1951 Professional Progress Award in Chemical

Engineering, sponsored by Celanese Corporation of America. The award which carries with it a prize of \$1,000, is administered by the American Institute of Chemical Engineers, and will be given at the organisation's annual meeting in December at Atlantic City.

The Awards Committee of the A.I.Ch.E., headed by Allen P. Colburn, provost of the University of Delaware, made the selection.

SIR ERNEST BENN has entered Oxted Cottage Hospital for treatment for a recurrence of the bronchial indisposition from which he suffered 18 months ago.

Six candidates were successful in the examinations for the Fellowship of the Royal Institute of Chemistry held in September. There were also 46 new Associates who qualified as announced in the Pass List just issued by the institute board of examiners.

The new Fellows are as follows:—Branch B (Old regulations): Physical Chemistry, with special reference to High Polymers—SIDNEY LUSTIGMAN, B.Sc. (Lond.).

Branch E: The Chemistry, including Microscopy, of Food and Drugs and of Water—THOMAS MORTON CLARK, B.Sc. (Lond.), SHARUT DATTATREYA GANGOLLI, B.Sc. (Benares), and WILLIAM HAROLD CULLEN SHAW.

Branch H: General Analytical Chemistry—EDWARD GORDON BROWN.

Branch I: Water Supply and the Treatment of Sewage and Trade Effluents—ALMA ARANSHAW CHRISTIE.

Obituary

The death is reported in a train accident at Weedon on 21 September of MR. F. A. PROFFITT, head of the Insecticides Division, and an executive member of The Geigy Co., Ltd., Manchester. Mr. Proffitt, who was 54 years of age, joined the company in 1935. His zeal for new causes was recognised when he took over responsibility for the development of DDT at the outset of its commercial peace-time application in the United Kingdom.

OVERSEAS

Belgian Oil Refinery in Production

Production has begun at Antwerp's first major oil refinery, which has a throughput of 1,400,000 metric tons a year. It is hoped to have an official opening next spring. The refinery, owned by SIBP (Société Industrielle Belge des Pétrole, S.A.) is a joint fifty-fifty venture of the Anglo-Iranian Oil Company and Petrofina. A new marine dock, which can accommodate two 28,000-ton tanks at the same time, has been constructed by the Antwerp port authorities.

To Expand Plant

A new deal has been worked out between the National Lead Company and the American Government whereby the company will spend \$5,000,000 to expand its facilities at Fredericktown, Missouri, and to build a cobalt, nickel and copper separation plant there.

The Defence Materials Procurement Agency will buy for five years all cobalt, nickel and copper produced by the new facilities and, in addition, will make an advance at 4 per cent interest payable in 20 equal instalments. The new plant is to be ready in 18 months.

Conservation Measures

The U.S. Government has reduced from 60 to 45 days' requirements the supply of aluminium that may be kept on inventory by manufacturers all other than makers of military aircraft.

An order will be issued allowing increases for lead and zinc scrap. Prices of these two primary metals were raised 2 cents a pound on October 2.

Malaya Surveys Tin

The Federal Mines Department and tin mining industry of Malaya are carrying out an investigation into the existing tin reserves on mine leases in the country, following a warning that tin reserves were rapidly being exhausted. The Chief Inspector of Mines states that the investigation will find out how much mining land has been worked and how much remains to be worked. Circulars and forms have been sent out to 760 mines in the country asking for detailed information on tin reserves and the expected duration of life on the mines.

Australia Reopens Copper Mines

Claims are again pegged in the Wallaroo Moonta copperfield of South Australia, at one time the richest copper area in Australia. It is 28 years since the mines were closed, because the workings were too deep, the yield had become too low, and the costs were too high. However, rising metal prices and the scarcity of copper in Australia have re-awakened interest. A syndicate has been formed to reopen the Poona mine—about two miles from Moonta.

U.S. Export Low Grade Iron Ore

The world's largest full-sized plant for the beneficiation of taconite iron ore will be built at Beaver Bay, Minnesota, by the Republic Steel Corporation of Cleveland, the Armco Steel Corporation of Middletown, and the National Steel Corporation of Pittsburgh. The project involves reduction of taconite ore from the east end of the Mesabi range. Geologists say there are 1,500,000,000 tons of this low grade ore in the area. Iron powder from the taconite is made into pellets containing 60 per cent iron compared to the natural ore of 50 per cent or less now being shipped down the Great Lakes.

Titanium Discovery in India

Deposits of ilmenite sands found in Bombay State may give India a world monopoly in titanium according to reports made by Indian Government geologists. The sands discovered in Ratnagiri, in Bombay, are claimed to contain up to 50 per cent of titanium. Exploitation of the ore will begin at once at an annual production of about 1,500 tons, but it is hoped to increase this to 5,000 tons by next year.

Zinc Smelter for India

Establishment of a zinc smelter in India is to be considered by a committee to be appointed by the Government of India. In addition to recommending a site for the smelter and the methods to be employed, the committee will advise the steps to be taken to assess the resources of the zinc ores available at the Zawar mines in Rajasthan, Central India, as well as in other parts of the country.

Publications & Announcements

ARRANGEMENTS have been made by Sunvic Controls Limited to manufacture and sell the range of pneumatic process control instruments manufactured by Moore Products Company, Philadelphia, U.S.A.

These arrangements are exclusive throughout the British Commonwealth, with the exception of Canada, and non-exclusive throughout the rest of the world, except U.S.A. and Canada.

The range of instruments will include pneumatic controllers, indicators, differential pressure transmitters, liquid level transmitters and controllers, thermometers, flow transmitters, valve positioners, manual control stations, relays, pilot valves, pressure regulators, etc.

FOLLOWING the successful completion of official tests, a new 3,000 p.s.i., three-stage air compressor designed and constructed by The Hymatic Engineering Company Ltd., of Redditch, Worcs., has just been given its type approval by the Ministry of Supply.

Designated the HC51, the compressor provides a free air delivery of 1.5 cu. ft. per min. at 1,500 r.p.m., under normally aspirated conditions, when delivering against a pressure of 3,000 p.s.i. Weighing only 10 lb., its overall dimensions are approximately 7 in. long, 6 in. wide and 8 in. high.

Although designed primarily for the operation of ancillary services in aircraft, this new compressor, the first fully developed and approved unit of such compact proportions and light weight, opens up many new possibilities for the application of compressed air in various fields of technical and scientific activity.

THE problem of exploiting the oil sands of Alberta, believed by many geologists to be the richest oil reserve in the world, has recently given rise to a new kind of extraction process invented by an American and claimed to be capable of producing oil from the sand beds at a cost of 5s. a barrel. Up to now experts have said that the best way of using the beds would be to mine the sand and then develop plants to extract the oil. Faintly Heath Robinson in flavour, the new method involves the distillation of oil direct from the sand. The inventor's plan is to

sink metal pipe heaters in the sand to a depth of 50 feet at intervals of 30 feet over a large circular area. As in the Ljungstrom process, the electrodes would be charged and the subsoil area heated. But instead of continuing the electrical heating, the idea is that the heat will force pores and tunnels through the mass, into which air or natural gas would be forced to give continuous combustion without electrical heat. With the subsoil temperature at 1,000°F., the partially cracked oil would, it is hoped, come to the surface and be recovered.

THE Power-Gas Corporation Ltd., Stockton-on-Tees, has recently brought out a leaflet on their P-A (Pease-Anthony) gas scrubbers. Two types are shown—the P-A Cyclonic Scrubber and the P-A Venturi scrubber—together with a combined version of the two. The venturi type scrubber is effective, say the company, against sub-micron dusts, fumes and mists, and the cyclonic type against micron-size dusts. Also published by the Corporation is a booklet on their industrial crystallisation plant (Krystal Process). This describes the mechanism of the Krystal Process, the various types of apparatus used in the crystallisation of various kinds of substance, and a number of applications for the process.

THE National Physical Laboratory is preparing a new short series of pamphlets describing the units and standards of measurement employed there. The first of the series, dealing with the fundamental units of length, mass and time, was published on 16 October. The pamphlet also defines the derivatives from these fundamentals, namely the units of volume, density and specific gravity and deals with the acceleration due to gravity, as well as with force and pressure, with particular reference to barometric pressure. Both the British Imperial system and the International Metric system are dealt with in the pamphlet.

'Units and Standards of Measurement employed at the National Physical Laboratory. I—Length, Mass and Time' is published for the DSIR by HMSO, price 9d. (25 cents U.S.A.) by post 10½d.

Next Week's Events

MONDAY 29 OCTOBER

Institution of Works Managers

Manchester: Grand Hotel, 6.30 p.m.
Open Forum.

TUESDAY 30 OCTOBER

The Chemical Society

Portsmouth: Municipal College, 7 p.m.
Joint meeting with the Portsmouth and District Chemical Society. Professor C. K. Ingold: 'Nitration and Nitrating Agents'.

Society of Instrument Technology, Ltd.

London: Manson House, Portland Place, W.1, 6.30 p.m. E. B. Moss (president): 'Development of Materials for Instrument Manufacture'.

Electrodepositors' Technical Society

Wealdstone: 2 p.m. Works visit to Kodak, Ltd.

WEDNESDAY 31 OCTOBER

Institute of Welding

Manchester: Reynolds Hall, College of Technology, 7 p.m. E. J. Mitchell: 'Can It Be Welded?'

THURSDAY 1 NOVEMBER

Royal Institute of Chemistry

Cambridge: University Chemical Laboratory, 8 p.m. A. E. Werner: 'The Chemistry and Physics of Paintings'.

The Chemical Society

Bristol: The University, 7 p.m. Joint meeting with the RIC and SCI. R. Belcher: 'Some Newer Methods in Analytical Chemistry'.

London: Burlington House, Piccadilly, W.1, 7.30 p.m. Reading of Original Papers.

Manchester: The University, 6.30 p.m. Reading of Original Papers.

The Royal Institution

London: 21 Albemarle Street, W.1, 5.15 p.m. First of a series of four lectures by Professor E. N. da C. Andrade and R. King: 'The Physics of the Deformation of Metals'.

Leeds Metallurgical Society

Leeds: The University, 7 p.m. R. Eborall: 'Some Structural Aspects of Recrystallisation'.

Plastics Institute

Manchester: College of Technology, 6.30 p.m. Professor W. T. Astbury (University of Leeds): 'Fibres and Chain-Molecules, Old and New'.

FRIDAY 2 NOVEMBER

The Chemical Society

St. Andrews: United College, 5.15 p.m., with St. Andrew's University Chemical

Society. Lecture by Professor F. G. Tryhorn.

Southampton: University College, 5 p.m., with Southampton University College Chemical Society. Dr. J. Baddiley: 'The Chemistry of Co-enzyme A'.

The Royal Institution

London: 21 Albemarle Street, W.1, 9 p.m. Sir John Cockcroft (director, Atomic Energy Research Establishment): 'Experiments with High Energy Nucleons and Quanta'.

Royal Institute of Chemistry

Manchester: Midland Hotel, 7.30 p.m., with SCI. Dinner and dance.

Society of Glass Technology

St. Helens: Gas Showrooms, Radiant House, 6 p.m. H. G. Jones and D. Townsend: 'The Air Cooling of Tank Blocks'.

Industrial Microscopy

AN exhibition 'How Industry is Using the Microscope' has been arranged by the Royal Microscopical Society (Industrial Section) to take place on Wednesday, 21 November, in the Great Hall, B.M.A. House, Tavistock Square, London, W.C.1, by kind permission of the British Medical Association. The exhibition will be opened by Mr. A. J. Philpot, the Director of the British Scientific Instruments Research Association, at 2.30 p.m. and will remain open until 9.30 p.m. Some forty exhibitors are taking part, including research associations and university departments as well as the research departments of a number of industrial firms, and the Department of Scientific and Industrial Research. The exhibits cover a wide range and can be classified as concerning mining and power; metallurgy; glass and ceramics; paint; paper, rubber and fabrics (including leather); photography; food and agriculture; pharmacy; and biology. The various modern forms of optical microscopy are represented in addition to electron microscopy. Apparatus and techniques of general and special application are being demonstrated as well as surface profile techniques for electron microscopy. The exhibition is well illustrated by photomicrographs and electron micrographs.

The exhibition is open to all and the catalogue of exhibits and further information can be obtained from the Assistant Secretary R.M.S., Tavistock House South.

British Chemical Prices

LONDON.—There has been a steady absorption of supplies in the general run of industrial chemicals, and the volume of new inquiry has been satisfactory for the period. Among the soda products, caustic soda—solid and liquid is in good request and an active interest is reported for yellow prussiate of soda, hyposulphate of soda and bichromate of soda. The potash chemicals are reported firm on a strong demand. In other directions hydrogen peroxide continues in steady call, and an active inquiry is reported for formaldehyde, borax, boric acid and the barium compounds. A fair buying interest is also reported for the solvents. Creosote oils and crude carbolic acid are active in a firm coal tar products market and there has been little change in the overall supply position.

General Chemicals

Acetic Acid.—Per ton : 80% technical, 1 ton, £110; 80% pure, 1 ton, £116; commercial glacial 1 ton, £129; delivered buyers' premises in returnable barrels; in glass carboys, £7; demijohns, £11 extra.

Acetic Anhydride.—Ton lots d/d, £166 per ton.

Acetone.—Small lots : 5 gal. drums, £105 per ton; 10 gal. drums, £100 per ton. In 40/50 gal. drums less than 1 ton, £85 per ton; 1 to 9 tons, £109 per ton; 10 to 50 tons, £108 per ton; 50 tons and over, £107 per ton.

Alcohol, Industrial Absolute.—50,000 gal. lots, d/d, 4s. 7½d. per proof gallon; 5000 gal. lots, d/d, 4s. 8½d. per proof gal.

Alcohol, Diacetone.—Small lots : 5 gal. drums, £133 per ton; 10 gal. drums, £128 per ton. In 40/45 gal. drums : less than 1 ton, £113 per ton; 1 to 9 tons, £112 per ton; 10 to 50 tons, £111 per ton; 50 to 100 tons, £110 per ton; 100 tons and over, £109 per ton.

Alum.—Loose lump, £17 per ton, f.o.r. MANCHESTER : Ground, £17 10s.

Aluminium Sulphate.—Ex works, £11 10s. per ton d/d. MANCHESTER : £11 10s.

Ammonia, Anhydrous.—1s. 9d. to 2s. 3d. per lb.

MANCHESTER.—Prices have maintained their firmness in all sections of the Manchester chemical market, the strength of which in respect of a number of products has been accentuated by the recent advance in sulphuric acid. Home-trade contracts are being drawn against steadily and new bookings from the domestic textile and allied trades and other leading industrial outlets, as well as on export account, have been on a satisfactory scale during the past week. Soda ash, caustic soda and other bread-and-butter lines are all coming in for attention from buyers. Business in the fertiliser market is no more than moderate, but in the tar products steady pressure for supplies in virtually all sections continues to be reported.

Ammonium Bicarbonate.—2 cwt. non-returnable drums; 1 ton lots £47 per ton.

Ammonium Chloride.—Grey galvanising, £27 10s. per ton, in casks, ex wharf. Fine white 98%, £21 10s. to £22 10s. per ton. See also Salammoniac.

Ammonium Nitrate.—D/d, £18 to £20 per ton.

Ammonium Persulphate.—MANCHESTER : £5 15s. per cwt. d/d.

Ammonium Phosphate.—Mono- and di-, ton lots, d/d, £88 and £86 10s. per ton.

Antimony Sulphide.—Golden, d/d in 5 cwt. lots as to grade, etc., 2s. 7d. to 3s. 8½d. per lb. Crimson, 4s. 1d., to 5s. 6d. per lb.

Arsenic.—Per ton, £44 5s. to £47 5s., ex store.

Barium Carbonate.—Precip., d/d; 2-ton lots, £33 5s. per ton, bag packing.

Barium Chloride.—£40 10s. 2 ton lots d/d bags.

Barium Sulphate (Dry Blanc Fixe).—Precip., 4-ton lots, £41 per ton d/d; 2-ton lots, £41 5s. per ton d/d.

Bleaching Powder.—£19 10s. per ton in casks (1 ton lots).

Borax.—Per ton for ton lots, in free 140-lb. bags, carriage paid: Anhydrous, £59 10s.; in 1-cwt. bags; commercial, granular, £39 10s.; crystal, £42; powder, £43; extra fine powder, £44; B.P., granular, £48 10s.; crystal, £51; powder, £52; extra fine powder £53.

Boric Acid.—Per ton for ton lots in free 1-cwt. bags, carriage paid: Commercial, granular, £68; crystal, £76; powder, £73 10s.; extra fine powder, £75 10s.; B.P., granular, £81; crystal, £88; powder, £85 10s.; extra fine powder, £87 10s.

Butyl Acetate BSS.—£263 per ton, in 10-ton lots.

Butyl Alcohol BSS.—£250 per ton, in 10-ton lots.

Calcium Bisulphide.—£6 10s. to £7 10s. per ton f.o.r. London.

Calcium Chloride.—70/72% solid £9 12s. 6d. per ton, in 4-ton lots.

Charcoal, Lump.—£25 per ton, ex wharf. Granulated, £30 per ton.

Chlorine, Liquid.—£28 10s. per ton d/d in 16/17-cwt. drums (3-drum lots).

Chrometan.—Crystals, 6d. per lb.

Chromic Acid.—1s. 10d. to 1s. 11d. per lb., less 2½%, d/d U.K.

Citric Acid.—Per lb., d/d buyers' premises, for 5 cwt. or over, anhydrous, 1s. 9d. plus 10%, other, 1s. 9d.; 1 to 5 cwt., anhydrous 1s. 9½d. plus 10%, other 1s. 9½d. Higher prices for smaller quantities. All subject to a trade discount of 5%.

Cobalt Oxide.—Black, delivered, 11s. 2d. per lb.

Copper Carbonate.—MANCHESTER: 2s. 6d. per lb.

Copper Chloride.—(63%), d/d, 2s. 9d. per lb.

Copper Oxide.—Black, powdered, about 1s. 4½d. per lb.

Copper Nitrate.—(63%), d/d, 2s. 8d. per lb.

Copper Sulphate.—£97 2s. 6d. per ton f.o.b., less 2%, in 2-cwt. bags.

Cream of Tartar.—100%, per cwt., about £13 12s. d/d.

Ethyl Acetate.—10 tons and upwards, d/d, £174 per ton.

Formaldehyde.—£33 per ton in casks, according to quantity, d/d.

Formic Acid.—85%, £66 to £67 10s. per ton, carriage paid.

Glycerine.—Chemically pure, double distilled 1,260 s.g. £14 9s. 0d. per cwt. Refined pale straw industrial, 5s. per cwt. less than chemically pure.

Hexamine.—Technical grade for commercial purposes, about 1s. 4d. per lb.; free-running crystals are quoted at 2s. 3d. to 2s. 6d. per lb.; bulk carriage paid.

Hydrochloric Acid.—Spot, 9s. 6d. to 10s. 9d. per carboy d/d, according to purity, strength and locality.

Hydrofluoric Acid.—59/60%, about 1s. to 1s. 2d. per lb.

Hydrogen Peroxide.—27.5% wt. £116 per ton. 35% wt. £146 per ton d/d. Carboys extra and returnable.

Iodine.—Resublimed B.P., 20s. 10d. per lb. in cwt. lots.

Iodoform.—24s. 9d. per lb. in cwt. lots.

Iron Sulphate.—f.o.r. works, £3 15s. to £4 5s. per ton. Bags free.

Lactic Acid.—Pale tech., 44 per cent by weight £120 per ton; dark tech., 44 per cent by weight £110 per ton ex works; Usual container terms.

Lead Acetate.—White: £194 10s. per ton.

Lead Carbonate.—Nominal.

Lead Nitrate.—£161 10s. per ton.

Lead, Red.—Basis prices per ton: Genuine dry red lead, £194; orange lead, £206. Ground in oil: red, £215; orange, £227.

Lead, White.—Basis prices: Dry English, in 8-cwt. casks, £200 10s. per ton. Ground in oil: English, under 2 tons, £216 10s.

Lime Acetate.—Brown, ton lots, d/d, £18 to £20 per ton; grey, 80-82%, ton lots, d/d, £22 to £25 per ton.

Litharge.—£194 per ton.

Lithium Carbonate.—7s. 9d. per lb. net.

Magnesite.—Calcedin, in bags, ex works, £27.

Magnesium Carbonate.—Light, commercial, d/d, £87 15s.; cwt. lots £97 10s. per ton d/d.

Magnesium Chloride.—Solid (ex wharf), £15 per ton.

Magnesium Oxide.—Light, commercial, d/d, £221; cwt. lots £227 10s. per ton d/d.

Magnesium Sulphate.—£12 to £14 per ton.

Mercuric Chloride.—Per lb., lump, 10s. 8d.; smaller quantities dearer.

Mercury Sulphide, Red.—Per lb., from 10s. 3d. for ton lots and over to 10s. 7d. for lots of 7 to under 30 lb.

Methanol.—Pure synthetic, d/d, £28 to £38 per ton.

Methylated Spirit.—Industrial 66° O.P. 100 gals., 7s. 10d. per gal.; pyridinised 64° O.P. 100 gal., 7s. 11½d. per gal.

Nickel Sulphate.—Deld. buyers U.K. £140 10s. per ton.

Nitric Acid.—£24 to £26 per ton, ex works.

Oxalic Acid.—About £146 per ton, packed in 5-cwt. lots, packed in free 5-cwt. casks.

Paraffin Wax.—Minimum 1-ton lots £76 5s.; smaller quantities £77.

Phosphoric Acid.—Technical (S.G. 1.500), ton lots, carriage paid, £67 per ton; B.P. (S.G. 1.750), ton lots, carriage paid, 1s. 2½d. per lb.

Potash, Caustic.—Solid, £88 10s. per ton for 1-ton lots; flake, £105 per ton for 1-ton lots. Liquid, d/d, nominal.

Potassium Bichromate.—Crystals and granular, 10½d. per lb.; ground, 11½d. per lb., for not less than 6 cwt.; 1-cwt. lots, ½d. per lb. extra.

Potassium Carbonate.—Calcined, 98/100%, £88 10s. per ton for 1-ton lots, ex store; hydrated, £81 for 1-ton lots.

Potassium Chlorate.—Imported powder and crystals, nominal.

Potassium Chloride.—Industrial, 96%, 6-ton lots, £16 10s. per ton.

Potassium Iodide.—B.P., 18s. 5d. per lb. in 28 lb. lots.

Potassium Nitrate.—Small granular crystals, 81s. per cwt. ex store, according to quantity.

Potassium Permanganate.—B.P., 1s. 7½d. per lb. for 1-cwt. lots; for 3 cwt. and upwards, 1s. 6½d. per lb.; technical, £8 3s. per cwt.; for 5 cwt. lots.

Potassium Prussiate.—Yellow, nominal.

Salammoniac.—Dog-tooth crystals, £72 10s. per ton; medium, £67 10s. per ton; fine white crystals, £21 10s. to £22 10s. per ton, in casks.

Salicylic Acid.—MANCHESTER: Technical 2s. 7d. to 2s. 10d. per lb. d/d.

Soda Ash.—58% ex depôt or d/d, London station, £8 17s. 3d. to £10 14s. 6d. per ton.

Soda, Caustic.—Solid 76/77%; spot, £21 12s. 6d. per ton d/d. (4 ton lots).

Sodium Acetate.—£85 to £91 per ton d/d.

Sodium Bicarbonate.—Refined, spot, £11 per ton, in bags.

Sodium Bichromate.—Crystals, cake and powder, 9d. per lb.; anhydrous, 9½d. per lb., net, d/d U.K. in 7-8 cwt. casks.

Sodium Bisulphite.—Powder, 60/62%, £40 per ton d/d in 2-ton lots for home trade.

Sodium Carbonate Monohydrate.—£25 per ton d/d in minimum ton lots in 2-cwt. free bags.

Sodium Chlorate.—£87 to £95 per ton.

Sodium Cyanide.—100% basis, 8d. to 9d. per lb.

Sodium Fluoride.—D/d, £4 10s. per cwt.

Sodium Hyposulphite.—Pea crystals £28 a ton; commercial, 1-ton lots, £26 per ton carriage paid.

Sodium Iodide.—B.P., 19s. 8d. per lb., in 28 lb. lots.

Sodium Metaphosphate (Calgon).—Flaked, loose in metal drums, £114 ton.

Sodium Metasilicate.—£21 5s. per ton, d/d U.K. in ton lots.

Sodium Nitrate.—Chilean Industrial, 97-98%, 6-ton lots, d/d station, £29 15s. per ton.

Sodium Nitrite.—£29 12s. 6d. per ton.

Sodium Percarbonate.—12½% available oxygen, £8 4s. per cwt. in 1-cwt. drums.

Sodium Phosphate.—Per ton d/d for ton lots: Di-sodium, crystalline, £34 10s., anhydrous, £73; tri-sodium, crystalline, £36 10s., anhydrous, £70.

Sodium Prussiate.—10d. to 10½d. per lb. ex store.

Sodium Silicate.—£6 to £11 per ton.

Sodium Silicofluoride.—Ex store, nominal.

Sodium Sulphate (Glauber Salt).—£8 per ton d/d.

Sodium Sulphate (Salt Cake).—Unground, £6 per ton d/d station in bulk. MANCHESTER: £6 10s. per ton d/d station.

Sodium Sulphide.—Solid, 60/62%, spot, £27 per ton, d/d, in drums; broken, £27 15s. per ton, d/d, in drums.

Sodium Sulphite.—Anhydrous, £57 12s. 6d. per ton; pea crystals, £35 7s. 6d. per ton d/d station in kegs; commercial, £22 per ton d/d station in bags.

Sulphur.—Per ton for 4 tons or more, ground, £25 18s. 6d. to £28 8s. according to fineness.

Tartaric Acid.—Per cwt.: 10 cwt. or more, £16 10s.

Tin Oxide.—1-cwt. lots d/d £25 10s. (Nominal.)

Titanium Oxide.—Comm., ton lots, d/d (56-lb./112 lb. bags), £115 per ton.

Zinc Oxide.—Maximum price per ton for 2-ton lots, d/d; white seal, £207 10s.; green seal, £206 10s.; red seal, £205.

Zinc Sulphate.—Nominal.

Rubber Chemicals

Antimony Sulphide.—Golden, 2s. 6½d. to 3s. 8d. per lb. Crimson, 3s. 6½d. to 4s. 9½d. per lb.

Arsenic Sulphide.—Yellow, 1s. 9d. per lb.

Barytes.—Off colour, ex store. Imported £13 10s per ton. Extra white bleached ex store, £16 10s.

Cadmium Sulphide.—About 20s. per lb.

Carbon Bisulphide.—£65 5s. per ton, according to quality.

Carbon Black.—6d. to 8d. per lb., according to packing.

Carbon Tetrachloride.—£69 10s. per ton.

Chromium Oxide.—Green, 2s. per lb.

India-rubber Substitutes.—White, 1s. 9½d. to 2s. 3d. per lb.; dark, 1s. 8½d. to 2s. 1½d. per lb.

Lithopone.—30%, £75 15s. per ton.

Mineral Black.—£7 10s. to £10 per ton.

Mineral Rubber, 'Rupron.'—£20 per ton.

Sulphur Chloride.—British 48s. 6d. per cwt.; Imported £120 per ton.

Vegetable Lamp Black.—£49 per ton.

Vermilion.—Pale or deep, 15s. 6d. per lb. for 7-lb. lots.

Nitrogen Fertilisers

Ammonium Sulphate.—Per ton in 6-ton lots, d/d farmer's nearest station, £15 7s. 6d.

Compound Fertilisers.—Per ton d/d farmer's nearest station, I.C.I. Special No. 1, £25 19s. 6d.

'Nitro-Chalk.'—£12 9s. 6d. per ton in 6-ton lots, d/d farmer's nearest station.

Sodium Nitrate.—Chilean agricultural for 6-ton lots d/d nearest station, £29 15s. per ton.

Coal-Tar Products

Benzol.—Per gal, ex works: 90's, 3s. 8½d.; pure, 3s. 11½d.; nitration grade, 4s. 2½d.

Carbolic Acid.—Crystals, 1s. 6d. to 1s. 8d. per lb. Crude, 60's, 8s. MANCHESTER: Crystals, 1s. 6½d. to 1s. 8d. per lb., d/d crude, 5s. 9d., naked, at works.

Creosote.—Home trade, 8d. to 10½d. per gal., according to quality, f.o.r. maker's works. MANCHESTER: 9d. to 11½d. per gal.

Cresylic Acid.—Pale 98%, 5s. 8d. per gal.; 99.5/100%, 5s. 10d. American, duty free, for export, 10s. naked at works.

Naphtha.—Solvent, 90/160°, 4s. 2½d. per gal. for 1000-gal. lots; heavy, 90/190°, 3s. 8d. per gal. for 1000-gal. lots, d/d. Drums extra; higher prices for smaller lots.

Naphthalene.—Crude, ton lots, in sellers' bags, £18 2s. 3d. to £29 5s. 9d. per ton according to m.p.; hot-pressed, £50 to £60 per ton, in bulk ex works; purified crystals, £60 to £70 per ton. F.O.B.

Pitch.—Medium, soft, home trade, 130s. per ton f.o.r. suppliers' works; export trade, 200s. per ton f.o.b. suppliers' port. MANCHESTER: £6 10s. f.o.r.

Pyridine.—90/160°, 27s. 6d. per gal. MANCHESTER: 35s. to 40s. per gal.

Toluol.—Pure, 4s. 7½d. per gal. MANCHESTER: Pure, 4s. 7½d. per gal. naked.

Xylol.—For 1000-gal. lots, 5s. 1½d. per gal., according to grade, d/d.

Wood Distillation Products

Calcium Acetate.—Brown, £15 per ton; grey, £22.

Methyl Acetone.—40/50%, £56 to £60 per ton.

Wood Creosote.—Unrefined, from 3s. 6d. per gal., according to boiling range.

Wood Naphtha.—Miscible, 4s. 6d. to 5s. 6d. per gal.; solvent, 5s. 6d. to 6s. 6d. per gal.

Wood Tar.—£6 to £10 per ton.

Intermediate and Dyes (Prices Nominal)

m-Cresol 98/100%.—3s. 9d. per lb. d/d.

o-Cresol 30/31° C.—1s. 4d. per lb. d/d.

p-Cresol 34/35° C.—3s. 9d. per lb. d/d.

Dichloraniline.—2s. 8½d. per lb.

Dinitrobenzene.—8½d. per lb.

Dinitrotoluene.—48/50° C., 9½d. per lb.; 66/68° C., 1s.

p-Nitraniline.—2s. 11d. per lb.

Nitrobenzene.—Spot, 5½d. per lb. in 90-gal. drums, drums extra, 1-ton lots d/d buyers' works.

Nitronaphthalene.—1s. 2d. per lb.; P.G. 1s. 0½d. per lb.

o-Toluidine.—1s. per lb., in 8/10-cwt. drums, drums extra.

p-Toluidine.—2s. 2d. per lb., in casks.

m-Xylidine Acetate.—4s. 5d. per lb., 100%.

ATLANTIC CROSSING

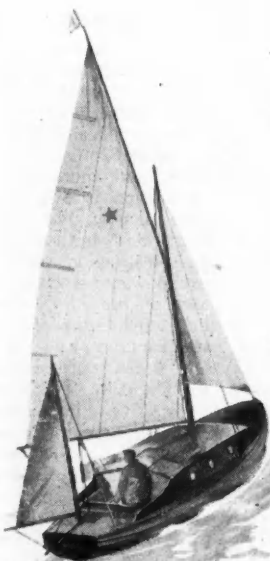
Mr. Stanley Smith and Mr. Charles Violet, now arrived in the United States from London's South Bank Exhibition in their 20 ft. craft, "Nova Espero", relied entirely on Permutit Sea Water Desalting Kits★ for providing all their drinking water, by direct treatment of sea water. This demonstrates that though these kits are designed for emergency use, they are capable of producing drinking water sufficient for over 90 days.

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★ Permutit Patents 576,969; 576,971; 582,345. D.S.I.R. Patent 590,725.

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Chemical & Allied Stocks & Shares

THERE have been warning indications that, owing to less favourable conditions in export markets and growing competition, many companies will find it difficult to maintain earnings in future and that some will have to reduce their dividends next year. In many directions, share values have already discounted City hopes that dividend limitation will not be enforced by law. Shares of companies expected to pay more, or who have already indicated that if limitation is dropped they will supplement recent dividends with additional payments, have been prominently active.

Share Bonus

Imperial Chemical, moved up to 53s. 3d. because the market confidently expects the 12 per cent dividend to be maintained if limitation is not brought in. Moreover, there is continued talk that I.C.I. may make a fresh application to the Capital Issues Committee for permission to distribute a share bonus. The company's previous application was turned down, it was stated at the annual meeting. But some other companies have been successful when renewed application has been made.

Fisons were up to 34s. in anticipation of good financial results, Monsanto Chemical have moved up to 30s. 3d., Albright and Wilson 5s. shares to 21s. 3d. and Brotherton 10s. shares were firm at 25s. Laporte Chemicals 5s. shares were 12s. 9d. and F. W. Berk 2s. 6d. shares changed hands around 7s. Hardman and Holden 5s. shares were 28s. 1½d. If dividend limitation is dropped the market confidently expects that the dividend total on the larger capital will be at least maintained at 27½ per cent, and there is talk of a possible increase to 30 per cent.

By the time these notes are in print, dealings will probably have started in the 5s. ordinary shares of the Eaglescliffe Chemical Company. Opening business is expected to be around 17s. on which basis there would be a yield of nearly 6 per cent, assuming the 20 per cent dividend rate is maintained. The company's main products are sulphuric acid, copper precipitate and superphosphates, compound fertilisers, and chrome salts. Recently it acquired over 90 per cent of the shares of E. Potter

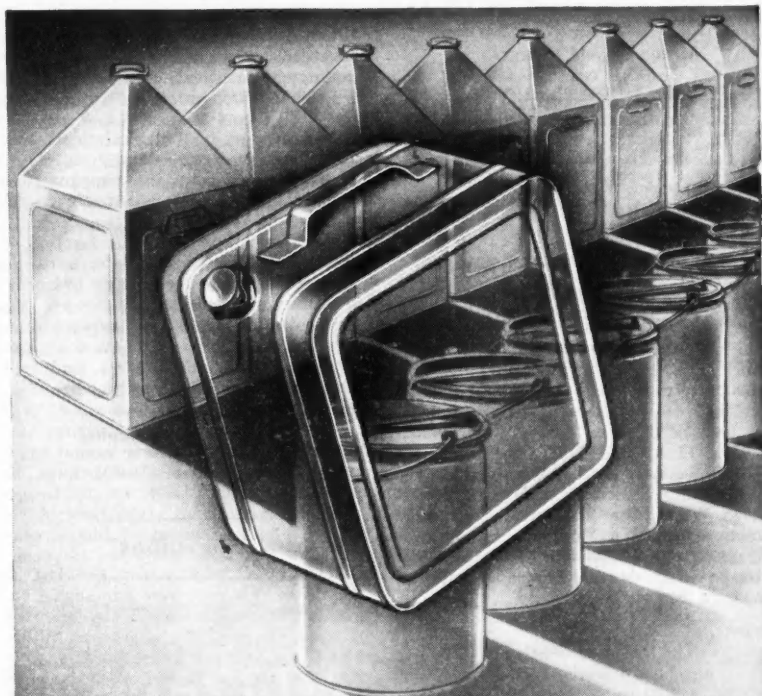
and Co., chemical manufacturers and merchants.

Associated Cement at 111s. 9d. have participated in the uptrend in shares of companies connected with the building industry. Glaxo were strong up to 88s. 1½d. on the talk of the possibility of a new issue to shareholders on favourable terms. British Celanese were also prominent up to 43s. on new issue hopes. Boots Drug 5s. units were 27s. and the 4s. units of the Distillers Co. 23s. 6d. British Xylonite moved up to 95s. and the 4s. units of British Glues and Chemicals have been firm and active around 15s. in their 'ex' bonus form.

Anglo-Iranian were £5½ and have held up well because of the company's important interests outside Persia. Shell were up to 98s. 1½d. in anticipation of shareholders receiving a total dividend of 15 per cent, tax free, if dividend limitation is not enforced.

Pharmaceutical Calendar

MUCH information of value to the pharmacist is contained in the 'Calendar of the Pharmaceutical Society of Great Britain 1951-52' just published by the Pharmaceutical Press (12s. 6d.) The growth and development of the society and its Scottish Department, its publications and museum, are briefly surveyed. Education is one of its principal aims, and the calendar gives details of examination regulations, institutes approved for providing instruction, scholarships, prizes, research awards and so on. There is a directory of branches of the society both in the United Kingdom and overseas. Full particulars are set out of the Poisons Act, and Rules, and the Dangerous Drugs Act and Regulations, including the Penicillin Act 1947, the Streptomycin Regulations, 1948, and the Aureomycin and Chloramphenicol Regulations, 1951. Under the heading of Legal Information a number of references to important court cases are quoted. An index enables any particular subject to be easily referred to. It seems rather an unfortunate time to produce the calendar. If it could not be completed earlier, surely it would have been better to delay publication until 1952.



In the Picture -

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Commercial Intelligence

The following are taken from the printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described herein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages or Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

PETROCHEMICALS, LTD., London, W. (M., 21/10/51). 29 August, mortgage supplemental to a trust deed dated 27 April, 1951, charged on leasehold premises comprised in a lease dated 2 May, 1951. *£4,300,000. 23 May, 1950.

THERMAL SYNDICATE, LTD., Wallsend. (M., 21/10/51). 6 September, £10,000 debentures, part of a series already registered. *£70,000. 13 April, 1951.

V. & E. PLASTICS, LTD., Macclesfield. (M., 21/10/51). 3 September, equitable mortgage, to Westminster Bank, Ltd., securing all moneys due or to become due to the bank; charged on Parsonage Billiard Hall, Parsonage Street, Macclesfield, and fixtures. *£1,634. 6 March, 1951.

New Registrations

Agrigano Fertilisers, Ltd.

Private company. (500,294). Capital £2,000. Directors: C. A. A. Miller and F. Shackleton. Reg. office: 137 High Crest, Orpington, Kent.

G. Makings, Ltd.

Private company. (499,877). Capital £100. Dealers in lime, limestone and similar minerals and mineral substances, chemicals, manures and fertilisers of all kinds, etc. Directors: G. Makings, Mrs. M. C. Makings, and K. Foley. Reg. office: 63 Prospect Hill, Leicester.

H. Carswell, Ltd.

Private company. (500,174). Capital £1,000. Wholesale or retail, consulting, analytical, manufacturing, pharmaceutical and general chemists, etc. Directors: H. Carswell. Reg. office: 9 Humber Road, Coventry.

Receivership

John B. Rubens has been appointed Receiver and Manager of EMMETT DISTRIBUTING CO., LTD.

Company News

Laporte Chemicals, Ltd.

The directors of Laporte Chemicals, Ltd., have declared an interim dividend of 2½ per cent actual, less income tax at 9s. 6d. in the £ payable 1 December, 1951 (same).

Evans Medical Supplies

At a meeting of the stockholders held on 17 October, an extraordinary resolution was passed which permits the company to issue £250,000 4½ per cent first mortgage debenture stock ranking *pari passu* with the £402,000 now outstanding.

At a board meeting held afterwards it was resolved that such stock forthwith be offered for subscription in cash at £99 per cent to the holders of the £402,000 now outstanding who were on the register at the close of business on 16 October, 1951, and application forms have been posted.

Increases of Capital

The following increase in capital has been announced:—ACALOR (1948), LTD., from £1,000 to £20,000.

Sulphur Allocations

QUOTAS of sulphur for the last three months of this year were announced by the International Materials Conference in Washington on 17 October.

Out of a total available supply of 1,407,818 tons of crude sulphur, nearly 75 per cent has been allocated to the U.S.A.—an increase of 48,000 tons over the last quarter. Britain receives the second largest amount with 102,300 tons, a reduction of 4,000 tons on her previous allotment.

The total supply for the fourth quarter of the year is divided between 32 countries and areas, and exceeds by 52,418 tons the figure for the third quarter which was allocated to 24 countries. Next largest recipients were Italy (36,000 tons), Australia (30,800 tons) and France (29,600 tons).

\$1,000,000 Expansion in Canada

A million dollar expansion to the Canadian Resins & Chemical Co. plant is under way at Shawinigan Falls, Quebec, and should be completed about next August. The new building will enable the company to produce substantially increased quantities of plastic Vinylite film, and will contain additional laboratory facilities for research and development of new products.

Chemical Engineering

THE first meeting of the session of the Institution of Chemical Engineers, North-Western Branch, was held at Manchester on 20 October, when Sir Harold Hartley, president, presented an address on 'Chemical Engineering and the Future'.

Sir Harold gave his impressions of his visit to the U.S.A. during September of this year. He found that chemical engineering is generally recognised there as a branch of engineering and he was pleased to find that Geo. E. Davis was regarded as a pioneer chemical engineer.

The world (he said) needed food, energy, metals, heavy and organic chemicals. The chemical reaction had entered into industrial life largely during the twentieth century and the standard of life in any country was proportional to the consumption of fuels for energy. Solar energy might be used to a greater extent in the future, in fact it was now used as a source of energy for hot water systems in Miami. Experts agreed that good sources of zinc, tin and lead were being depleted fairly quickly and sufficient supplies would be maintained only by the treatment of low grade ores.

The processes of nature were extremely complex and the probability of carrying out such processes on an industrial scale was remote, although enzyme systems were being used to supply the needs of mankind.

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Applications, furnishing details of age, qualifications, and experience, together with the names and addresses of two persons to whom reference may be made, should be forwarded to the **CHIEF PERSONNEL OFFICER, NORTH WESTERN GAS BOARD, LIVERPOOL GROUP, RADIAN HOUSE, BOLD STREET, LIVERPOOL, 1**, within 14 days of the issue of this advertisement.

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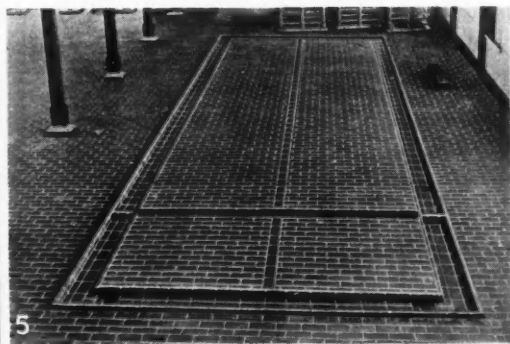
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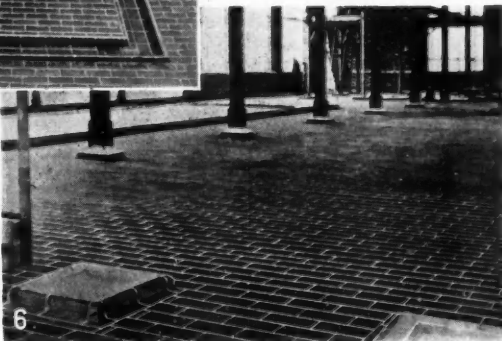
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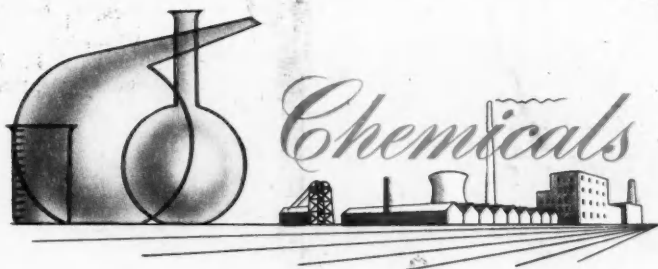
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